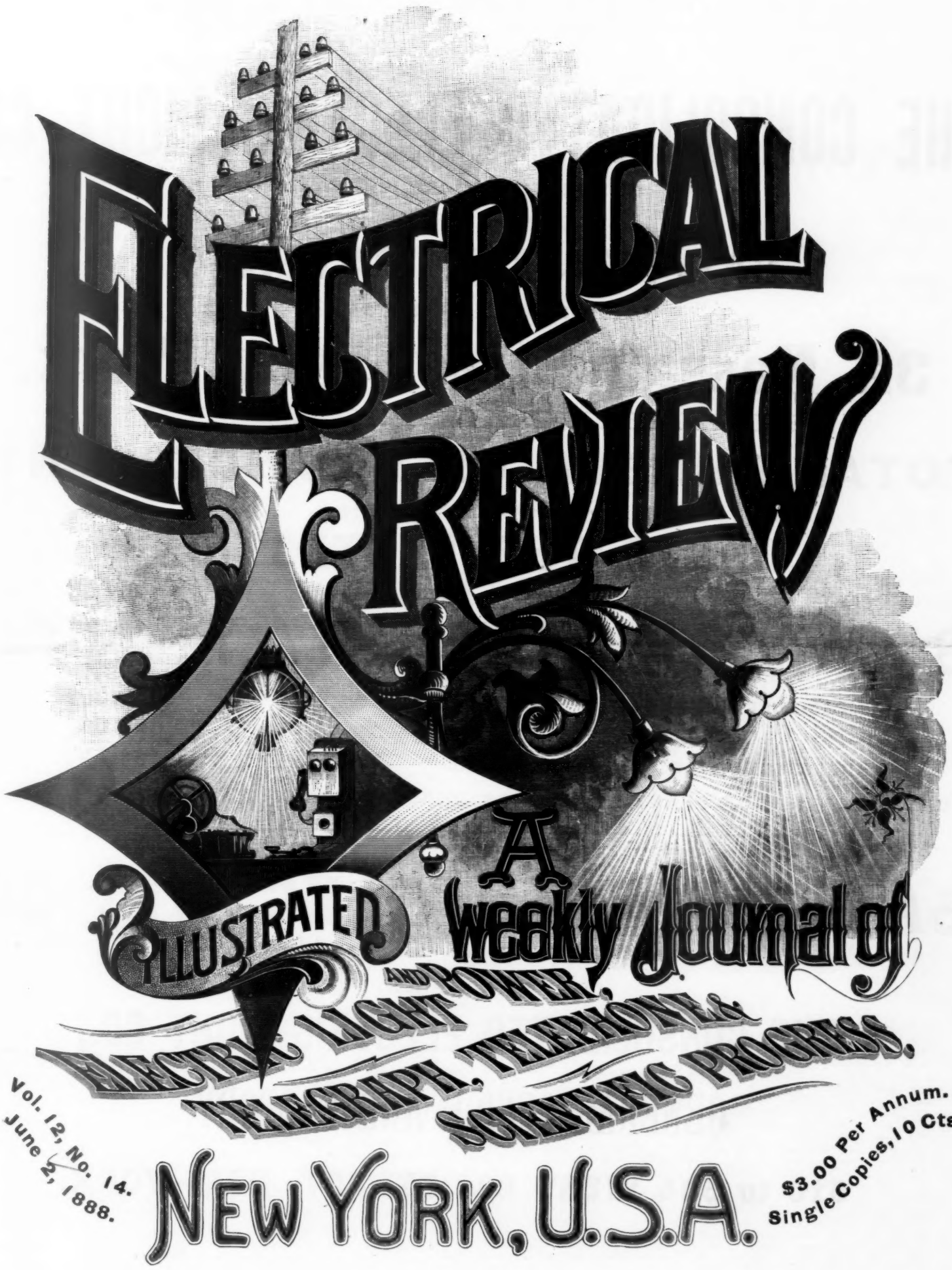

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THE CONSOLIDATED ELECTRIC LIGHT CO.

GEORGE WESTINGHOUSE, Jr., President,

OWNERS OF THE

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GENERAL OFFICE:

32 Nassau Street, New York.

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UNDER THE PROTECTION

OF THE

SAWYER-MAN PATENTS,

December 15, 1887,	308,302
April 15, 1888,	460,063
Increase for the Last Four Months,	151,761

DETAILED LIST OF PLANTS AND STATIONS WILL BE MAILED ON APPLICATION.

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GENERAL OFFICE AND FACTORY,

510 to 534 WEST 23d STREET, NEW YORK.

ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

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Thomson-Houston Motor in a Printing Office.

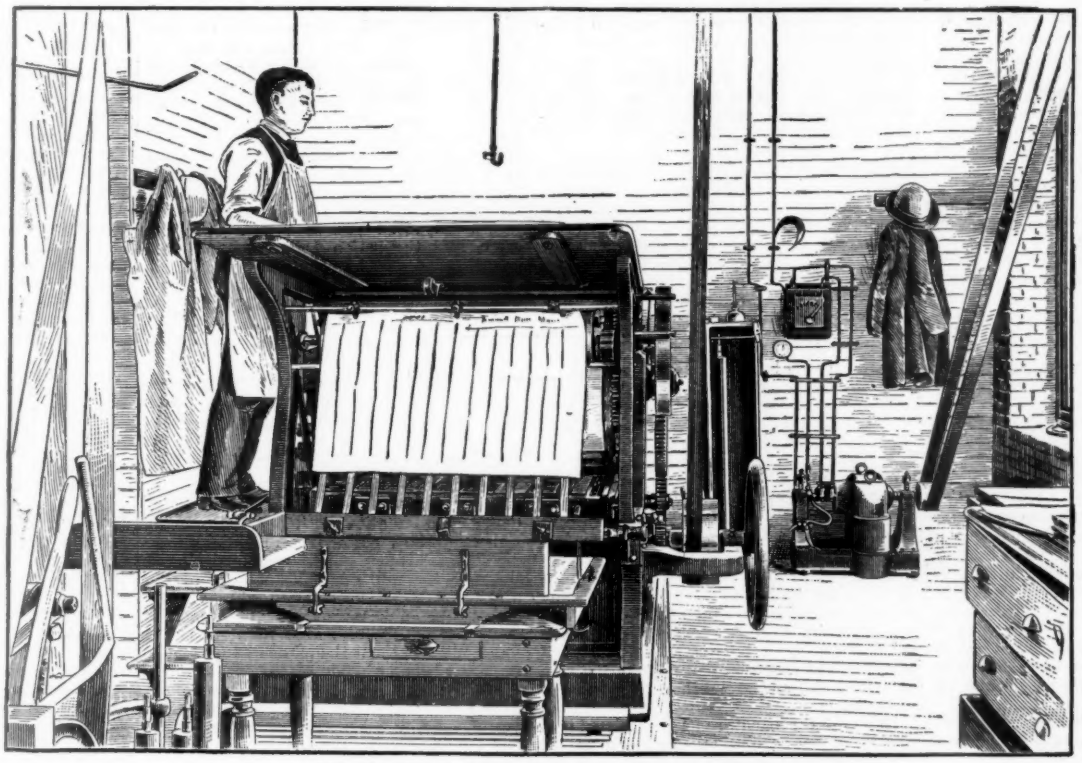
Among the many successful motor installations made by the Thomson-Houston Electric Company may be mentioned that of the Lowell Daily *News*, which is shown in the accompanying engraving. The first edition of that paper printed after the motor had been put in, contained the following editorial.

"NEW AND NOVEL ENGINE THAT RUNS THE 'NEWS' PRESSES.

"Ever on the alert for improvements, the *News* has placed in its pressroom a most novel and remarkable motive power, an electric motor; and it is the first machine of its kind ever set up in the city. Heretofore, we used an ordinary boiler and engine, the former of five, and the latter of four horse-power, to run our machinery; and they have worked far from satisfactory. Besides not fulfilling all claimed for them by their makers, they have been, like all boilers and engines, a constant source of expense and annoyance, while their refuse was nothing less than a nuisance to the printing office.

"The electric motor relieves all this. It is but three horse power, yet it runs our six presses without any perceptible effort. By simply moving a little lever it starts up, and furnishes a firm, steady, easy power, until stopped, requiring only a little oiling once a day.

"This motor, which occupies only about two square feet of floor space, is manufactured by the Thomson-Houston Electric Company of Boston, and costs but little more than an ordinary steam engine which would furnish an equal amount of power. The electricity for running it is supplied by the Middlesex Electric Light Company, at a reasonable price. The Thomson-Houston Company guarantees that the repairs on the machine will be practically nothing, the only expense being the renewal of what is called 'brushes,' at a cost of about two dollars or three dollars a year. These motors are made from one-half to seventy-five horse-power."



THE ELECTRIC MOTOR AND THE PRINTING PRESS.

This was April 18th, 1887, and since that time the motor has been in daily operation, furnishing power for six large presses. It has never given any trouble, has needed no repairs, and has performed its work in a perfectly satisfactory manner.

The proprietors of the paper have expressed in the strongest manner, the entire satisfaction at its successful operation.

Fire Destroys an Up-town Exchange of the Metropolitan Telephone Company.

The Thirty-ninth street exchange of the Metropolitan Telegraph and Telephone Company was burned out Wednesday night of last week. The operating room, where the fire broke out at few minutes past 10 o'clock, is on the top floor of the four-story building at the southeast corner of Thirty-ninth street and Sixth avenue.

The wires, including heavy cables, covers the top of the building, and in the operating room was one of the large switchboards. Its multiple connections covered the largest circuit in the city. The damage to the building will not exceed $2,000, and damage to tenants by smoke and water about $1,000. General Manager Eckert said that the damage would not exceed $50,000. The exchange cannot be operated for several days.

The Gas Question.

The report of Professor Spice upon the quality of gas illumination furnished by the street lamps is decidedly interesting. Professor Spice finds that the lamps which he tested range from four candle-power to fourteen and one-eighth, the standard being fifteen. In no instance was the light sufficient; in many it was less than half what the city has the right to expect. The burners are choked by rust and the pressure insufficient.

The price which the city pays for gas lighting is quite high enough. The contracts should be so drawn as to preclude the possibility in future of such damaging disclosures as Professor Spice has just made. And if the burners in common use are unfit for out-of-door service on account of their liability to rust, they should be replaced by better ones. The gas companies can amply afford to furnish good light for the money they get.—*Brooklyn Daily Times.*

No Money for Electric Lights.

At Belvidere, N. J., the Common Council having refused to appropriate $1,500 per annum for electric lights for street purposes, the town is now in darkness and the citizens are very indignant. The electric plant belongs to John Maker, of Philadelphia, and will be removed from the place during the present week unless the money is made up by private subscription.

The Telephone and The Telegraph.

THE FORMER SHOWED GREATER CAPACITY, BUT THE OTHER WIRE DID BETTER NEWSPAPER WORK.

The following accounts of the competitive dash between the telephone and telegraph are of interest to all our readers, many of whom are watching the advance of the telephone into the fields of the telegraph. The following is from the New York *Sun's* account:

A unique race took place in the dismal rain yesterday afternoon between two famed competitors in annihilating time and space. It was a hotly contested ten-minute dash from the *Sun* office in Printing House square to the office of the *Boston Herald*. The competitors were the fleet Long Distance Telephone and that dandy speeder, the *Sun's* Special Wire. The race was designed to decide the respective merits of the two lightning rivals on the swift transmission of news.

The start was made from the *Sun* office on Printing House square, just as the City Hall clock marked 5.07 o'clock. The telephone toed the mark on a corner of the fireproof file room, on the third floor of the *Sun's* new building, and the special wire came to the scratch on the second floor. Both were started at precisely the same moment by a signal given by a *Sun* reporter, and simultaneously tackled the task of delivering in Boston, in the best possible shape, with the least possible delay, a section of the *Sun's* despatch from California, printed in yesterday's paper, about the attack of Chinese pirates upon the steamship "San Pablo," wrecked on a reef off Turnabout Island, in the Formosa Straits, off the China coast. Anybody who reads the despatch can see for himself that it is a narrative in which diphthongs and unfamiliar names have the call on the vowels and simpler words that both the telephone and the telegraph can most readily transmit. * * * * *

Time was called at 5.17 o'clock exactly, and each of the transmitters in the *Sun* building checked off with a pencil the number of words he had succeeded in starting in a race for Boston, and then shook hands laughingly, and awaited news by telegraph of the result of the conflict. Comparisons made in the meantime in the *Sun* office by the *Sun's* reporter showed that the expert telephone transmitter had succeeded in sending 346 words over the long distance wire, and that the expert telegrapher had rattled of 330 words, exclusive of punctuation marks, and had spelt out each word. This is equal to an average transmission of 1,980 words an hour. The telephone operator had stopped but thrice to spell out words. One of these was "Turnabout" and the other was "Reed," the name of the captain of the wrecked steamer. The rest of the despatch that he sent was understood without difficulty by the receiver. The operator said that it wasn't necessary for him to call out the punctuation of the despatch to the receiver. He could indicate by the inflection of his voice in sending the message the appropriate punctuation of the sentences he talked at the telephone.

But that the receiver at the Hub end of the competiton hadn't fully comprehended the meaning of these inflections was shown by the message that came to the *Sun* over the telegraph wire thirteen minutes after the test announcing the result.

* * * The expert backers of the rival racers asked, after the test, that another race be arranged, with the conditions changed, so that the test message could be reproduced at the finish by a typewriter. The advocates of each competitor declared that this condition would enable the electric racers to attain their highest degree of efficiency as servants of the newspapers.

The following we take from the Boston *Herald:*

"An interesting trial took place yesterday afternoon which was intended to be a practical test of the comparitive merits of the telegraph and the telephone, with special reference to their utility in the newspaper business. Over the *Herald's* regular New York wire, the operator, at his desk in the *Herald* office, 'took' 330 words of a message sent by an operator located in the *Sun* office. The time occupied was exactly ten minutes. Perfectly clear and entirely legible was the 'copy'; in fact, just the same as is produced in regular business over the same wire. Seated at a 'phone at the office of the Long-Distance Telephone Company on Devonshire street a *Herald* representative 'took' 337words of the same matter and at the same time. As will be seen, the number of words in each case was practically the same. But it should be stated that the 'copy' of the telephone receiver was not wholly legible, although in the main fit to go to the compositor. When it is considered that the gentleman taking from the 'phone was not accustomed to taking 'rush matter,' and only aimed to get as many words as possible without attempting a perfect copy, the test, as made, would seem to indicate that the telephone can hold its own with the telegraph. There is one important additional point which should not be overlooked. To take a telegraph message one must needs be an operator. Any person who can hear and write legibly can take a 'phone message."

The REVIEW hopes to see another test made at an early day.

A New System of Alternate Current Motors and Transformers.

BY NIKOLA TESLA.—READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, MAY 16, 1888.

In the presence of the existing diversity of opinion regarding the relative merits of the alternating and continuous current systems, great importance is attached to the question whether alternate currents can be successfully utilized in the operation of motors. The transformers, with their numerous advantages, have afforded us a relatively perfect system of distribution, and although, as in all branches of the art, many improvements are desirable, comparatively little remains to be done in this direction. The transmission of power, on the contrary, has been almost entirely confined to the use of continuous currents, and notwithstanding that many efforts have been made to utilize alternate currents for this purpose; they have, up to the present, at least as far as known, failed to give the result desired. Of the various motors adapted to be used on alternate current circuits the following have been mentioned: 1. A series motor with subdivided field. 2. An alternate current generator having its field excited by continuous currents. 3. Elihu Thomson's motor. 4. A combined alternate and continuous current motor. Two more motors of this kind have suggested themselves to me. 1. A motor with one of its circuits in series with a transformer and the other in the secondary of the transformer. 2. A motor having its armature circuit connected to the generator and the field coils closed upon themselves. These, however, I mention only incidentally.

The subject which I now have the pleasure of bringing to your notice is a novel system of electric distribution and transmission of power by means of alternate currents, affording peculiar advantages, particularly in the way of motors, which I am confident will at once establish the superior adaptability of these currents to the transmission of power, and will show that many results heretofore unattainable can be reached by their use; results which are very much desired in the practical operation of such systems, and which cannot be accomplished by means of continuous currents.

Before going into a detailed description of this system, I think it necessary to make a few remarks with reference to certain conditions existing in continuous current generators and motors, which, although generally known, are frequently disregarded.

In our dynamo machines, it is well known, we generate alternate currents, which we direct by means of a commutator, a complicated device, and, it may be justly said, the source of most of the troubles experienced in the operation of the machines. Now, the currents so directed cannot be utilized in the motor, but they must—again by means of a similar unreliable device—be reconverted into their original state of alternate currents. The function of the commutator is entirely external, and in no way does it affect the internal working of the machines. In reality, therefore, all machines are alternate current machines, the currents appearing as continuous only in the external circuit during their transit from generator to motor.

In view simply of this fact, alternate currents would commend themselves as a more direct application of electrical energy, and the employment of continuous currents would only be justified if we had dynamos which would primarily generate, and motors which would be directly actuated by such currents.

But the operation of the commutator on a motor is two-fold; firstly, it reverses the currents through the motor, and secondly, it effects, automatically, a progressive shifting of the poles of one of its magnetic constituents. Assuming, therefore, that both of the useless operations in the system, that is to say the directing of the alternate currents on the generator and reversing the direct currents on the motor, be eliminated, it would still be necessary, in order to cause a rotation of the motor, to produce a progressive shifting of the poles of one of its elements, and the question presented itself, How to perform this operation by the direct action of alternate currents? I will now proceed to show how this result was accomplished.

In the first experiment a drum-armature was provided with two coils at right angles to each other, and the ends of these coils were connected to two pairs of insulated contact-rings as usual. A ring was then made of thin insulated plates of sheet iron and wound with four coils, each two opposite coils being connected together so as to produce free poles on diametrically opposite sides of the ring. The remaining free ends of the coils were then connected to the contact-rings of the generator armature so as to form two independent circuits, as indicated in Fig. 9. It may now be seen what results were secured in this combination, and with this view I would refer to the diagrams, Figs. 1 to 8*a*. The field of the generator being independently excited, the rotation of the armature sets up currents in the coils *c c*, varying in strength and direction in the well-known manner. In the position shown in Fig. 1 the current in coil *c* is nil while coil c^1 is traversed by its maximum current, and the connections may be such that the ring is magnetized by the coils *c c*, as indicated by the letters *N S* in Fig. 1*a*, the magnetizing effect of the coils *c c* being nil, since these coils are included in the circuit of coil *c*.

In Fig. 2 the armature coils are shown in a more advanced position, one-eighth of one revolution being completed. Fig. 2*a* illustrates the corresponding magnetic condition of the ring. At this moment the coil *c* generates a current of the same direction as previously, but weaker, producing the poles n_1 s_1 upon the ring; the coil *c* also generates a current of the same direction, and the connections may be such that the coils *c c* produce the poles *n s*, as shown in Fig. 2*a*. The resulting polarity is indicated by the letters *N S*, and it will be observed that the poles of the ring have been shifted one-eighth of the periphery of the same.

In Fig. 3 the armature has completed one-quarter of one revolution. In this phase the current in coil *C* is a maximum, and of such direction as to produce the poles *N S* in Fig. 3*a*, whereas the current in coil c_1 is nil, this coil being at its neutral position. The poles *N S* in Fig. 3*a* are thus shifted one-quarter of the circumference of the ring.

Fig. 4 shows the coils *c c* in a still more advanced position, the armature having completed three-eighths of one revolution. At that moment the coil *c* still generates a current of the same direction as before, but of less strength, producing the comparatively weaker poles *n s* in Fig. 4*a*. The current in the coil *c* is of the same strength, but of opposite direction. Its effect is, therefore, to produce upon the ring the poles n_1 and s_1 as indicated, and a polarity *N S* results, the poles now being shifted three-eighths of the periphery of the ring.

In Fig. 5 one-half of one revolution of the armature is completed, and the resulting magnetic condition of the ring is indicated in Fig. 5*a*. Now, the current in coil *c* is nil, while the coil *c* yields its maximum current, which is of the same direction as previously; the magnetizing effect is therefore due to the coils *c c* alone, and, referring to Fig. 5*a*, it will be observed that the poles *N S* are shifted one-half of the circumference of the ring. During the next half-revolution the operations are repeated, as represented in the Figs. 6 to 8*a*.

A reference to the diagrams will make it clear that during one revolution of the armature the poles of the ring are shifted once around its periphery, and each revolution producing like effects, a rapid whirling of the poles in harmony with the rotation of the armature is the result. If the connections of either one of the circuits in the ring are reversed, the shifting of the poles is made to progress in the opposite direction, but the operation is identically the same. Instead of using four wires, with like result, three wires may be used, one forming a common return for both circuits.

This rotation or whirling of the poles manifests itself in a series of curious phenomena. If a delicately pivoted disc of steel or other magnetic metal is approached to the ring it is set in rapid rotation, the direction of rotation varying with the position of the disc. For instance, noting the direction outside of the ring it will be found that inside the ring it turns in an opposite direction, while it is unaffected if placed in a position symmetrical to the ring. This is easily explained. Each time that a pole approaches it induces an opposite pole in the nearest point on the disc and an attraction is produced upon that point; owing to this, as the pole is shifted further away from the disc a tangential pull is exerted upon the same, and the action being constantly repeated, a more or less rapid rotation of the disc is the result. As the pull is exerted mainly upon that part which is nearest to the ring, the rotation outside and inside, or right and left, respectively, is in opposite directions. When placed symmetrically to the ring, the pull on opposite sides of the disc being equal, no rotation results. The action is based on the magnetic inertia of the iron; for this reason a disc of hard steel is much more affected than a disc of soft iron, the latter being capable of very rapid variations of magnetism. Such a disc has proved to be a very useful instrument in all these investigations, as it has enabled me to detect any irregularity in the action. A curious effect is also produced upon iron filings. By placing some upon a paper and holding them externally quite close to the ring they are set in a vibrating motion, remaining in the same place, although the paper may be moved back and forth; but in lifting the paper to a certain height which seems to be dependent on the intensity of the poles and the speed of rotation, they are thrown away in a direction always opposite to the supposed movement of the poles. If a paper with filings is put flat upon the ring and the current turned on suddenly, the existence of a magnetic whirl may be easily observed.

To demonstrate the complete analogy between the ring and a revolving magnet, a strongly energized electro-magnet was rotated by mechanical power, and phenomena identical in every particular to those mentioned above were observed.

Obviously the rotation of the poles produces corresponding inductive effects, and may be utilized to generate currents in a closed conductor placed within the influence of the poles. For this purpose it is convenient to wind a ring with two sets of superimposed coils, forming respectively the primary and secondary circuits. In order to secure the most economical results, the magnetic circuit should be completely closed, as shown in Fig. 10, and with this object in view the construction may be modified at will.

The inductive effect exerted upon the secondary coils will be mainly due to the shifting or movement of the magnetic action; but there may also be currents set up in the circuits in consequence of the variations in the intensity of the poles. However, by properly designing the generator and determining the magnetizing effect of the primary coils, the latter element may be made to disappear. The intensity of the poles being maintained constant, the action of the apparatus will be perfect, and the same result will be secured as though the shifting were effected by means of a commutator with an infinite number of bars. In such case the theoretical relation between the energizing effect of each set of primary coils and their resultant magnetizing effect may be expressed by the equation of a circle having its center coinciding with that of an orthogonal system of axes, and in which the radius represents the resultant, and the co-ordinates both of its components. These are then respectively the sine and cosine of the angle a between the radius and one of the axis ($O X$). Referring to Fig. 11 we have $r^2 = x^2 + y^2$; where $x = r \cos a$, and $y = r \sin a$.

Assuming the magnetizing effect of each set of coils in the transformer to be proportional to the current—which may be admitted for weak degrees of magnetization—then $x = K c$ and $y = K c^1$, where K is a constant and c and c^1 the current in both sets of coils respectively. Supposing further, the field of the generator to be uniform, we have for constant speed $c^1 = K^1 \sin a$ and $c = K^1 \sin (90° + a) = K^1 \cos a$, where K^1 is a constant. See Fig 12.

Therefore $x = K c = K K^1 \cos a$,

$y = K c^1 = K K^1 \sin a$, and

$K K^1 = r$.

That is, for a uniform field the disposition of the two coils at right angles will secure the theoretical result, and the intensity of the shifting poles will be constant. But from $r^2 = x^2 + y^2$ it follows that for $y=0$, $r = x$; it follows that the joint magnetizing effect of both sets of coils should be equal to the effect of one set when at its maximum action. In transformers and in a certain class of motors the fluctuation of the poles is not of great importance, but in another class of these motors it is desirable to obtain the theoretical result.

In applying this principle to the construction of motors, two typical forms of motor have been developed. First, a form having a comparatively small rotary effort at the start, but maintaining a perfectly uniform speed at all loads, which motor has been termed synchronous. Second, a form possessing a great rotary effort at the start, the speed being dependent on the load.

These motors may be operated in three different ways: 1. By the alternate currents of the source only. 2. By a combined action of these and of induced currents. 3. By the joint action of alternate and continuous currents.

The simplest form of a synchronous motor is obtained by winding a laminated ring provided with pole projections with four coils, and connecting the same in the manner before indicated. An iron disc having a segment cut away on each side may be used as an armature. Such a motor is shown in Fig. 9. The disc being arranged to rotate freely within the ring in close proximity to the projections, it is evident that as the poles are shifted it will, owing to its tendency to place itself in such a position as to embrace the greatest number of the lines of force, closely follow the movement of the poles, and its motion will be synchronous with that of the armature of the generator; that is, in the peculiar disposition shown in Fig. 9, in which the armature produces by one revolution two current impulses in each of the circuits. It is evident that if, by one revolution of the armature, a greater number of impulses is produced, the speed of the motor will be correspondingly increased. Considering that the attraction exerted upon the disc is greatest when the same is in close proximity to the poles, it follows that such a motor will maintain exactly the same speed at all loads within the limits of its capacity.

To facilitate the starting, the disc may be provided with a coil closed upon itself. The advantage secured by such a coil is evident. On the start the currents set up in the coil strongly energize the disc and increase the attraction exerted upon the same by the ring, and the currents are generated in the coil as long as the speed of the armature is inferior to that of the poles. Considerable

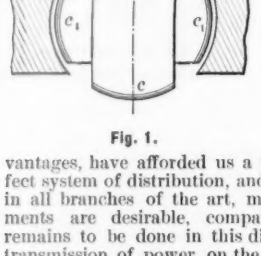


Fig. 1.

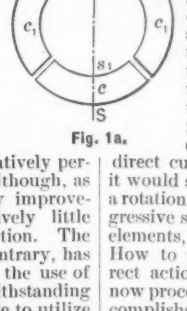


Fig. 1a.

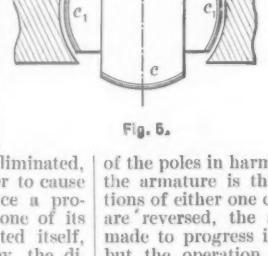


Fig. 5.

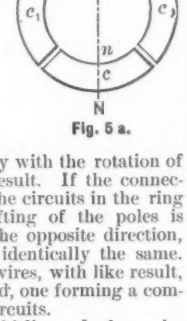


Fig. 5 a.

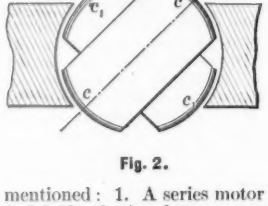


Fig. 2.

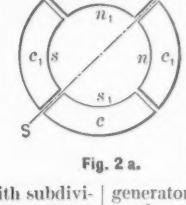


Fig. 2 a.

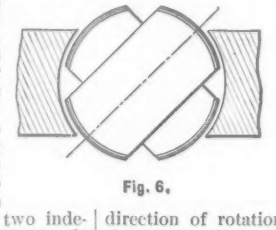


Fig. 6.

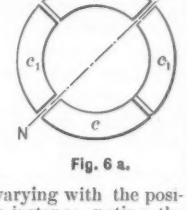


Fig. 6 a.

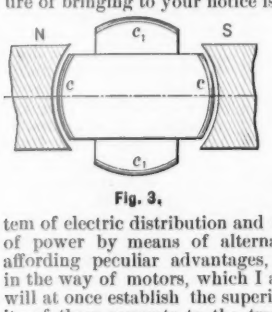


Fig. 3.

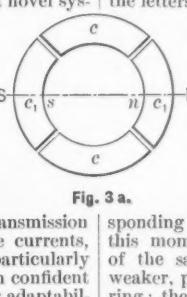


Fig. 3 a.

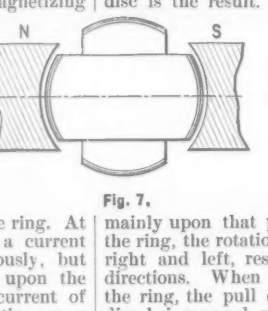


Fig. 7.

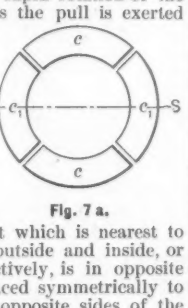


Fig. 7 a.

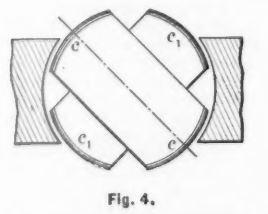


Fig. 4.

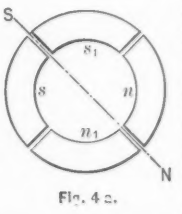


Fig. 4 a.

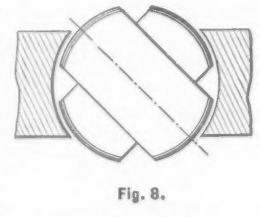


Fig. 8.

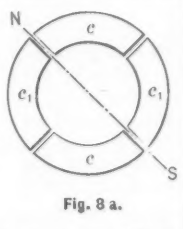


Fig. 8 a.

work may be performed by such a motor even if the speed be below normal. The intensity of the poles being constant, no currents will be generated in the coil when the motor is turning at its normal speed.

Instead of closing the coil upon itself, its ends may be connected to two insulated sliding rings, and a continuous current supplied to these from a suitable generator. The proper way to start such a motor is to close the coil upon itself until the normal speed is reached, or nearly so, and then turn on the continuous current. If the disc be very strongly energized by a continuous current the motor may not be able to start,

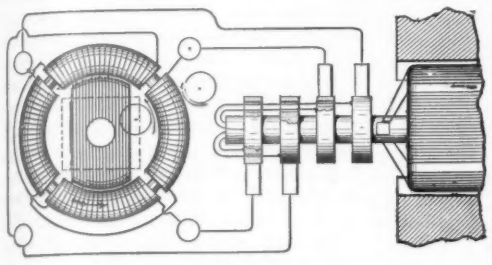


Fig. 9.

but if it be weakly energized, or generally so that the magnetizing effect of the ring is preponderating it will start and reach the normal speed. Such a motor will maintain absolutely the same speed at all loads. It has also been found that if the motive power of the generator is not excessive, by checking the motor the speed of the generator is diminished in synchronism with that of the motor. It is characteristic of this form of motor that it cannot be reversed by reversing the continuous current through the coil.

The synchronism of these motors may be demonstrated experimentally in a variety of ways. For this purpose it is best to employ a motor consisting of a stationary field magnet and an armature arranged to rotate within the same, as indicated in Fig. 13. In this case the shifting of the poles of the armature

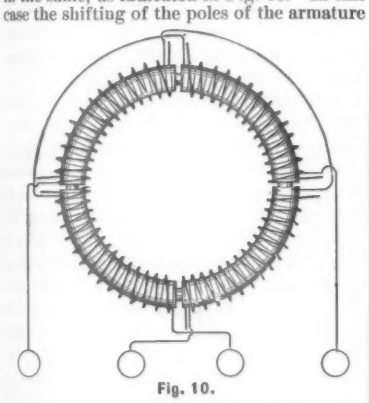


Fig. 10.

produces a rotation of the latter in the opposite direction. It results therefrom that when the normal speed is reached the poles of the armature assume fixed positions relatively to the field magnet and the same is magnetized by induction, exhibiting a distinct pole on each of the pole pieces. If a piece of soft iron is approached to the field magnet it will at the start be attracted with a rapid vibrating motion produced by the reversals of polarity of the magnet, but as the speed of the armature increases the vibrations become less and less frequent and finally entirely cease. Then the iron is weakly but permanently attracted, showing that the synchronism is reached and the field magnet energized by induction.

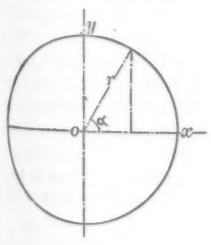


Fig. 11.

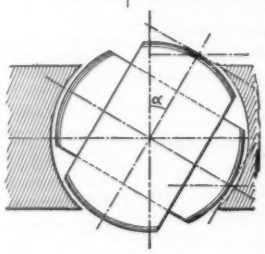


Fig. 12.

The disc may also be used for the experiment. If held quite close to the armature it will turn as long as the speed of rotation of the poles exceeds that of the armature; but when the normal speed is reached, or very nearly so, it ceases to rotate and is permanently attracted.

A crude but illustrative experiment is made with an incandescent lamp. Placing the lamp in circuit with the continuous current generator, and in series with the magnet coil, rapid fluctuations are observed in the light in consequence of the induced currents set up in the coil at the start; the speed increasing, the fluctuations occur at longer intervals, until they entirely disappear, showing that the motor has attained its normal speed.

A telephone receiver affords a most sensitive instrument; when connected to any circuit in the motor the synchronism may be easily detected on the disappearance of the induced currents.

In motors of the synchronous type it is desirable to maintain the quantity of the shifting magnetism constant, especially if the magnets are not properly subdivided.

To obtain a rotary effort in these motors was the subject of long thought. In order to secure this result it was necessary to make such a disposition that while the poles of one element of the motor are shifted by the alternate currents of the source, the poles produced upon the other element should always be maintained in the proper relation to the former, irrespective of the speed of the motor. Such a condition exists in a continuous current motor; but in a synchronous motor, such as described, this condition is fulfilled only when the speed is normal.

The object has been attained by placing within the ring a properly subdivided cylindrical iron core, wound with several independent coils closed upon themselves. Two coils at right angles are sufficient, but a greater number may be advantageously employed, as in Fig. 14. It results from this disposition that when the poles of the ring are shifted, currents are generated in the closed armature coils. These currents are the most intense at or near the points of the greatest density of the lines of force, and their effect is to produce poles upon the armature at right angles to those of the ring, at least, theoretically so; and since this action is entirely independent of the speed—that is, as far as the location of the poles are concerned—a continuous pull is exerted upon the periphery of the armature. In many respects these motors are similar to the continuous current motors. If load is put on, the speed, and also the resistance of the motor, is diminished, and more current is made to pass through the energizing coils, thus increasing the effect. Upon the load being taken off, the counter electro-motive force increases, and less current passes through the primary or energizing coils. Without any load, the speed is very nearly equal to that of the shifting poles of the field magnet.

It will be found that the rotary effort in these motors fully equals that of the continuous current motors. The effort seems to be greatest when both armature and field magnet are without any projections; but as in such dispositions the field cannot be very concentrated, probably the best results will be obtained by leaving pole projections on one of the elements only. Generally it may be stated that the projections diminish the torque and produce a tendency to synchronism.

A characteristic feature of motors of this kind is their capacity of being very rapidly reversed. This follows from the peculiar action of the motor. Suppose the armature to be rotating and the direction of rotation of the poles to be reversed. The apparatus then represents a dynamo machine, the power to drive this machine being the momentum stored up in the armature and its speed being the sum of the speeds of the armature and the poles. If we now consider that the power to drive such a dynamo would be very nearly proportional to the third power of the speed, for this reason alone the armature should be quickly reversed. But simultaneously with the reversal another element is brought into action; namely, as the movement of the poles with respect to the armature is reversed, the motor acts like a transformer in which the resistance of the secondary circuit would be abnormally diminished by producing in this circuit an additional electro-motive force. Owing to these causes the reversal is instantaneous.

If it is desirable to secure a constant speed, and at the same time a certain effort at the start, this result may be easily attained in a variety of ways. For instance, two armatures, one for torque and the other for synchronism, may be fastened on the same shaft, and any desired preponderance may be given to either one, or an armature may be wound for rotary effort, but a more or less pronounced tendency to synchronism may be given to it by properly constructing the iron core; and in many other ways.

As a means of obtaining the required phase of the currents in both the circuits, the disposition of the two coils at right angles is the simplest, securing the most uniform action; but the phase may be obtained in many other ways, varying with the machine employed. Any of the dynamos at present in use may be easily adapted for this purpose by making connections to proper points of the generating coils. In closed circuit armatures, such as used in the continuous current systems, it is best to make four derivations from equi-distant points or bars of the commutator, and to connect the same to four insulated sliding rings on the shaft. In this case each of the motor circuits is connected to two diametrically opposite bars of the commutator. In such a disposition the motor may also be operated at half the potential and on the three-wire plan, by connecting the motor circuits in the proper order to three of the contact rings.

In multipolar dynamo machines, such as use the converter systems, the phase is conveniently obtained by winding upon the armature two series of coils in such a manner that while the coils of one set or series are at their maximum production of current, the coils of the other will be at their neutral position, or nearly so, whereby both sets of coils may be subjected simultaneously or successively to the inducing action of the field magnets.

Generally the circuits in the motor will be similarly disposed, and various arrangements may be made to fulfill the requirements; but the simplest and most practicable is to arrange primary circuits on stationary parts of the motor, thereby obviating, at least in certain forms, the employment of sliding contacts. In such a case the magnet coils are connected alternately in both the circuits; that is, 1, 3, 5 in one, and 2, 4, 6 in the other, and the coils of each set of series may be connected, all in the same manner, or alternately in opposition; in the latter case a motor with half the number of poles will result and its action will correspondingly modified.

The employment of multipolar motors secures in this system an advantage much desired and unattainable in the continuous current system, and that is, that a motor may be made to run exactly at a predetermined speed irrespective of imperfections in construction, of the load, and, within certain limits, of electromotive force and current strength.

In a general distribution system of this

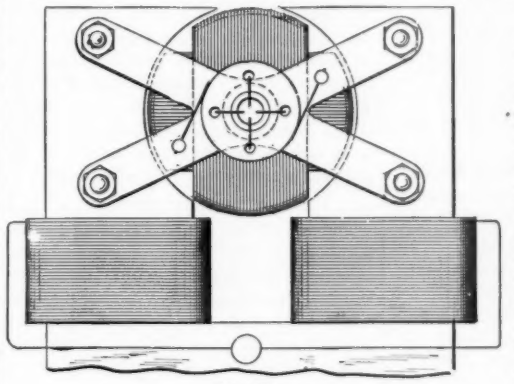


Fig. 13.

kind the following plan should be adopted. At the central station of supply, a generator should be provided having a considerable number of poles. The motors operated from this generator should be of the synchronous type, but possessing sufficient rotary effort to insure their starting. With the observance of proper rules of construction it may be admitted that the speed of each motor will be in some inverse proportion to its size, and the number of poles should be chosen accordingly. Still, exceptional demands may modify this rule. In view of this, it will be advantageous to provide each motor with a greater number of pole projections or coils, the number being preferably a multiple of two and three. By this means, by simply changing the connections of the coils, the motor may be adapted to any probable demands.

If the number of the poles in the motor is even, the action will be harmonious and the proper result will be obtained; if this is not the case, the best plan to be followed is to make a motor with a double number of poles and connect the same in the manner before indicated, so that half the number of poles result. Suppose, for instance, that the generator has twelve poles and it would be desired to obtain a speed equal to $\frac{1}{3}$ of the speed of the generator. This would require a motor with seven pole projections or magnets, and such a motor could not be properly connected in the circuits, unless fourteen armature coils would be provided, which would necessitate the employment of sliding contacts. To avoid this the motor should be provided with fourteen magnets and seven connected in each circuit, the magnets in each circuit alternating among themselves. The armature should have fourteen closed coils. The action of the motor will not be quite as perfect as in the case of an even number of poles, but the drawback will not be of a serious nature.

However, the disadvantages resulting from this unsymmetrical form will be reduced in the same proportion as the number of the poles is augmented.

If the generator has, say, n, and the motor n_1 poles, the speed of the motor will be equal to that of the generator multiplied by $\frac{n}{n_1}$.

The speed of the motor will generally be dependent on the number of the poles, but

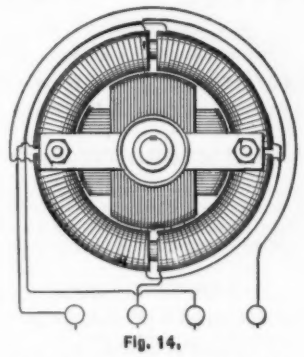


Fig. 14.

there may be exceptions to this rule. The speed may be modified by the phase of the currents in the circuits or by the character of the current impulses or by intervals between each or between groups of impulses. Some of the possible cases are indicated in the diagrams, Figs. 18, 19, 20 and 21, which are self-explanatory. Fig. 18 represents the condition generally existing, and which secures the best result. In such a case, if the typical form of motor illustrated in Fig. 14 is employed, one complete wave in each circuit will produce one revolution of the motor. In Fig. 19 the same result will be effected by one wave in each circuit; in Fig. 20 by two, and in Fig. 21 by four waves.

By such means any desired speed may be attained; that is, at least within the limits of practical demands. This system possesses this advantage besides others, resulting from simplicity. At full loads, the motors show an efficiency fully equal to that of the continuous current motors. The transformers present an additional advantage in their capability of operating motors. They are capable of similar modifications in construction, and will facilitate the introduction of motors and their adaptation to practical demands. Their efficiency should be higher than that of the present transformers, and I base my assertion on the following:

In a transformer as constructed at present, we produce the currents in the secondary circuit by varying the strength of the primary or exciting currents. If we admit proportionality with respect to the iron core, the inductive effect exerted upon the secondary coil will be proportional to the numerical sum of the variations in the strength of the exciting current per unit of time; whence it follows that for a given variation any prolongation of the primary current will result in a proportional loss. In order to obtain rapid variations in the strength of the current, essential to efficient induction, a great number of undulations are required and employed From this various disad-

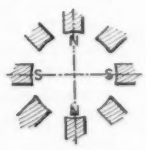


Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

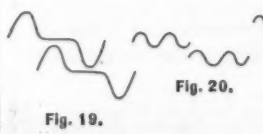


Fig. 19.

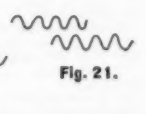


Fig. 21.

Fig. 20.

vantages result. These are, increased cost and diminished efficiency of the generator, more waste of energy in heating the cores, and also diminished output of the transformer, since the core is not properly utilized, the reversals being too rapid. The inductive effect is also very small in certain phases, and there may be periods of inaction, if there are intervals between the succeeding current impulses or waves. In producing a shifting of the poles in the transformer, and thereby inducing currents, the induction is of the ideal character, being always maintained at its maximum action.

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We invite correspondence from Electricians, Inventors, and the Telegraph and Telephone fraternity and those engaged in Electric Lighting, on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

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Electric light stations do not explode.

What has become of the S. P. C. A. that they do not grasp this splendid opportunity of releasing hundreds of horses from their miserable experiences in dragging street cars?

The electric light in Hannibal, Mo., is so popular that the Republicans and Democrats are quarreling over the question of who should have the honor of introducing it and securing its adoption.

No use, gentlemen. The electric railway is a thing of the present. It knocks at the doors of this great city with no timid taps, and will get in if every alderman of them all has to be swept into the bay.

Alderman Dowling has a new theory of electricity: it will ooze out of the storage battery under the body of a street car like the froth out of a champagne bottle, climb up and infest the nails, lurk in the tacks and screws, and slug to death the incautious mortal who leans up against the aforesaid nail, tack or screw. Yet, the alderman must be right, for he "is conversant with machinery." Wonder if he doesn't mean political machinery, and confines his knowledge to the necessity of copious lubrication—greasing?

The New York *Tribune* in an editorial last Sunday, compliments the Electric Club as follows: "It is interesting to observe that, while the old established clubs, with whose names every one is familiar, are enjoying, apparently without exception, a remarkable prosperity, new clubs have multiplied by the score, usually along the line of some special interest in society, politics or business. The formation of the Electric Club is a striking example not only of this tendency, but of the development of an industry already of enormous importance in our daily life, and yet, in reality, only a few years old."

The first contest between the long distance telephone and the telegraph in the matter of sending newspaper "copy" from New York to Boston, occurred last week. The result, while not a victory, must have been gratifying to the telephone people, as it proved that the capacity of the improved instrument is greater than the telegraph, and that a rapid writer, experienced in furnishing printers' copy, would have won with the telephone. In the ten minutes devoted to the test, more words were received by the telephone than by the telegraph. The point is made by the Boston *Herald* that any one who can hear and write can use the telephone, as against trained telegraph operators required by the telegraph. Accounts of the trial, which we hope to see repeated, appear on another page.

THE BELL COMPANY'S LOAN.

Immediately following the refusal of the Supreme Court to reopen the Drawbaugh case, the American Bell Telephone Company issued a circular to its stockholders inviting them to subscribe for bonds to the extent of two millions of dollars. These bonds bear seven per cent. interest and are redeemable after two years at 110. At these figures the privilege of taking these bonds at par gives a "right" to each share which is worth about two dollars in the open market, a number of sales having already been made at that figure. The money received for these bonds is to be used in extending the long distance work, which, it is understood, will be pushed very vigorously during the coming summer and fall.

We have heard from several sources expressions of disappointment that the "melon" which rumor has long said would certainly be "cut" as soon as the Supreme Court pronounced in favor of the Bell Company, did not prove larger and more juicy. To be sure it was nothing but rumor, no promise and nothing approaching a promise having been made, but upon this very airy foundation hopeful stockholders, backed by the "street," seem to have built what to them was a very substantial structure, involving nothing less than the distribution among them of "rights" to subscribe for and take the stock of the American Telephone and Telegraph Company.

We do not claim to be in any way in the confidence of the directors of the American Bell, nor have we any better means of judging what the future is to bring forth than any one else who will take pains to consider the matter carefully, but we venture the opinion that it will be a very long time before the stock of the American Telephone and Telegraph Company is used as a plum to tickle the palates of the Bell stockholders.

It will some day dawn upon these stockholders who are so anxious for a slice of the Company's property beyond the customary dividends that the directors are taking a conservative view, that they take into the account the fact that their patents will one day expire, and that to pay out in dividends all or nearly all earnings would be, in a sense, to pay out the capital. Something should be saved to take the place of the patents, so that, when they are gone, there may be property in the hands of the company to represent the full capital stock. That such will be the case no one who has taken the trouble to examine the annual reports of assets and liabilities can possibly doubt.

It would be well if the operating telephone companies, licensees of the American Bell, would pursue the same policy. After the expiration of the fundamental patents in '93 and '94, a certain amount of competition or attempt at competition is to be expected. But companies which have gradually increased their plants until they have a value close upon the amount of their capital stock, so that good will, rights of way and contracts figure for nothing—have been wiped out, in fact—will have an advantage which will be a practical bar to competion, and will discourage all attempts in that direction, for it would be very difficult to enlist capital in any such enterprise.

We happen to know that more than one operating telephone company has definitely adopted this policy, annually charging off a certain per centage of the value placed upon the patent franchise, so that when the patent term expires it will stand at nothing, and the whole capital stock will have visible, tangible, money-earning property behind it, dollar for dollar, and in addition, whatever rights of way and other privileges the company may have obtained, as well as the contract with the Bell Company. And we have noted that the stock of the companies which have definitely entered upon this course is in quick demand at high figures, and that very little of it is to be had.

USE LIGHTNING ARRESTERS.

At Seward, Nebraska, there is a 600 incandescent plant of the Westinghouse converter system. The plant has been doing excellent work, and giving perfect satisfaction. But on the 7th instant it rather got the worst of it in a little controversy with nature's static system. Either from jealousy, or some other unexplained cause, lightning swooped down upon the plant, and wiped out seven converters. While the occurrence was decidely annoying and temporarily deranged matters, the damage was not serious. By rewinding a portion of the converter and borrowing a few from Lincoln, the trouble was remedied with but little delay.

There is a lesson in this little catastrophe. No outside line should ever be run—no matter what the system—over a central district without lightning arresters; and the better these lines are insulated the greater the danger from want of such protection. The induction static capacity of a well insulated line, even of comparatively short extent, is occasionally a source of surprise to linemen and others. A line which was put up at one of the race tracks in Chicago a few years ago, when it was proposed to speed horses by night, was abandoned after a short season, and the wire taken down. There had been no current on the line for some hours, and the generator was disconnected, yet the parties who were removing the wire received several quite severe shocks, until one end of the wire became grounded, and as one of the linemen said, "drained off the current."

Now, no electric light line can be thoroughly and equally well insulated at every point. The weakest point will carry off the charge, and the lightning arrester should be at that point.

OUR CHICAGO LETTER.

(Special Correspondence.)

The Central Electric Company, since its removal, has been enabled to distribute over several floors and a basement what had formerly been crowded upon a single floor. Under the new order of arrangements the chaos incidental to crowding and piling things has been done away with, and the brothers McKinlock are happier than ever. The boys report business lively, especially mentioning recent sales of 7½ miles of "Candee" wire for the stock yards company's circuit of arcs; 14 miles for a plant at Adrian, Mich.; and 3½ miles for Hiawatha, Kan.

The second floor of the same building contains the office and salesroom of the National Electric Construction Company. This company is doing a general wiring business, and has recently completed a plant of 73 arc and 150 glow lamps in one of the street-car stables at Twenty-first street. The well-known Russell engines, of Massilon, Ohio, will operate the dynamos.

Mr. A. A. Robinson, representing the Detroit Motor Company, just from the northwest, passed through the city on Thursday last. He complains of good business and plenty of it.

The Duluth Fire Alarm Station has had a curious experience with some high tension electricity. Upon a table where the two fire alarm circuits came into the office, were a two circuit repeater, two testing keys and galvanometers, and other apparatus for each of these circuits. Like all fire alarm circuits of the Gamewell system, these are metallic, and testing for a ground is done by means of a galvanometer and ground contact through a species of plug switchboard. The two circuits are independent of each other, but by some means a route for the current has been made across the table by either a static charge from the clouds or a heavy electric light current (most likely the former), from the two lines to the testing wire and instruments and to ground, so that whenever a ground contact came on either circuit outside, the galvanometer showed a heavy deflection, but no sooner was the outside or second ground removed than the galvanometer came back to zero. The table is a wooden one, and the fibre is sufficiently carbonized to make it a partial conductor, and as there is quite apt to be a small leak from line to ground, the keys are to be put on rubber bases, after which the galvanometer and the operators will then be protected from further annoyance.

Paul Kauvar, Steele Mackey's latest success, has been, for several nights on the boards at Hooley's Theatre, and it was deemed desirable to obtain photographs of the various stage settings of the play. The Chicago Arc Light and Power Company were pressed into service, and lighted the stage with a dozen Thomson-Houston arc lamps for the purpose. The sittings were had after the matinees of Wednesday and Saturday, and the pictures were highly satisfactory.

In the sweet bye and bye, or afterwards, the Ft. Wayne Jenney people will have a very convenient, commodious and elegant office in the Temple Court building, but just now Buckley and his little army are quartered in a sort of over-the-stairs bed room, a cross between a look-out and an *entre sol*, perhaps, and the boys have to hold each other's feet when they are all in for want of room. It will be better soon.

Leonard & Izard are hardly better off in their new quarters in the "Rookery." The paint and varnish fiends are worrying them, and until the ornamentation is finished there will be that peculiar pungent odor that always comes with new furniture, and old doctors who believe in turpentine as a "remejial agent," bring with them in the green apple season. And the Thomson-Houston boys in their new home are happy as crickets in the front offices and are settled. But the back rooms and the down stairs part look for all the world as if a cyclone of "temporary" had struck there. It is easy to see, however, that but a short time must elapse before perfect order will usurp the present chaotic condition of affairs.

Superintendent Cushing, of the Arc Light and Power Company, has just returned from a long and far away vacation with renewed health and vigor. He still converses fluently in ordinary United States notwithstanding his long absence.

May 28, 1888. C. C. H.

OUR BOSTON LETTER.

(Special Correspondence.)

The Wednesday evening talk before the Electric Club was given last week by Mr. G. L. Lang, superintendent of telegraph on the New York and New England Railroad. Mr. Lang was greeted by a large audience and gave an interesting sketch of the electrical devices used by railway companies, illustrating his remarks by an exhibition of apparatus, notably the modern automatic train despatcher. At the close of the paper a discussion was opened which drew forth remarks from nearly all present and brought out many interesting points.

On Saturday evening the club was entertained at its rooms by a paper, by Mr. G. W. Mansfield, entitled "A Sketch of Elevated Railroad Systems and their Adaptability for Electric Propulsion." Mr. Mansfield began with the first elevated railway known, Jacob's ladder, and discussed all the forms of such roads from the earliest times down to the present. The advantages and fitness of the electric motor as a means of propulsion on such roads, was next taken up and the point urged that electricity was the only suitable power to be so used. At the conclusion of the paper a short discussion was taken part in by Capt. Griffin, Mr. Wilson, Col. Hewins, Mr. W. O. Webber and others. Adjournment was then taken up stairs and an hour or so spent in doing justice to the repast there temptingly displayed by Caterer Dooling. The club is in a particularly prosperous condition just now. Members are taking an increased interest, the club rooms are much more used and a long list of new members is posted for the June meeting. The subscription roll for the club's anniversary is beginning to attain goodly proportion.

The Revere Electric Street Railroad Company is about to begin work of construction. Locations have been secured in Revere for some time past. The officers of the company are: Washington G. Benedict, president; Horace B. Parker, vice-president; William A. Boland, of the Thomson-Houston Company, treasurer; and Arthur D. McClellan, attorney.

Mr. W. S. Hill, of Oliver street, has just gotten out an attractive illustrated catalogue of his own electrical specialties, some of which were illustrated in the REVIEW a short time ago. There is already a large demand for the catalogue as well as for other information concerning his inventions, which are sure to fill a want in the electrical field.

Particulars are now given out concerning the purchase by C. L. Richardson of the Hoosac Valley street railway at North Adams, Mass. The plant was purchased for the Thomson-Houston Company of this city, and the Van de Poele electric system will be immediately installed. The length of the line is at present five miles. The central station will probably be erected in North Adams. The officers of the reorganized company are: C. L. Richmond, president and treasurer; Eugene Griffin, vice-president; and S. P. Thayer, clerk. $75,000 is said to be the amount paid, the new company assuming all indebtedness.

Mr. F. J. Sprague has been a Boston visitor lately.

The Hewin's electric car is again in commission between Boston and Cambridge.

The Meigs Elevated Railroad bill has at last passed both houses of the Legislature and received the governor's signature.

Boston, May 28, 1888. T. W. S.

The judgment entered against the American Electric Manufacturing Company of No. 3 East 14th street, amounting to $19,962, was promptly paid on Saturday last. This adjusts the difficulties of this company, which on a very slight pretext were heralded so widely in the daily press.

Inventor Tesla Replies to Dr. Louis Duncan, Explaining His Alternating Current Motor.

TO THE EDITOR OF ELECTRICAL REVIEW:

I find in your issue of last week a note of Mr. Duncan referring to my system of alternate current motors.

As I see that Dr. Duncan has not as yet been made acquainted with the real character of my invention, I cannot consider his article in the light of a serious criticism and would think it unnecessary to respond; but desiring to express my consideration for him and the importance which I attach to his opinion, I will point out here briefly the characteristic features of my invention, inasmuch as they have a direct bearing on the article above referred to.

The principle of action of my motor will be well understood from the following:

By passing alternate currents in proper manner through independent energizing circuits in the motor, a progressive shifting or rotation of the poles of the same is effected. This shifting is more or less continuous according to the construction of the motor and the character and relative phase of the currents employed, and I have indicated the theoretical conditions which should exist in order to secure the most perfect action.

If a laminated ring be wound with four coils, and the same be connected in proper order to two independent circuits of an alternate current generator adapted for this purpose, the passage of the currents through the coils produces theoretically a rotation of the poles of the ring, and in actual practice in a series of experiments, I have demonstrated the complete analogy between such a ring and a revolving magnet. From the application of this principle to the operation of motors, two forms of motor of a character widely differing have resulted, one designed for constant and the other for variable load. The misunderstanding of Dr. Duncan is due to the fact that the prominent features of each of these two forms have not been specifically stated. In illustration of a representative of the second class, I refer to Fig. 1, on page 1 of ELECTRICAL REVIEW of May 12th. In this instance, the armature of the motor is provided with two coils at right angles. As it may be believed that a symmetrical arrangement of the coils with respect to the poles is required, I will assume that the armature is provided with a great number of diametrically wound coils or conductors closed upon themselves, and forming as many independent circuits. Let it now be supposed that the ring is permanently magnetized so as to show two poles (N and S) at two points diametrically opposite, and that it is rotated by mechanical power. The armature being stationary, the rotation of the ring magnet will set up currents in the closed armature coils. These currents will be most intense at or near the points of the greatest density of the force, and they will produce poles upon the armature core at right angles to those of the ring. Of course there will be other elements entering into action which will tend to modify this, but for the present they may be left unconsidered. As far as the location of the poles upon the armature core is concerned, the currents generated in the armature coils will always act in the same manner, and will maintain continuously the poles of the core in the same position, with respect to those of the ring in any position of the latter, and independently of the speed. From the attraction between the core and the ring, a continuous rotary effort, constant in all positions, will result, the same as in a continuous current motor with a great number of armature coils. If the armature be allowed to turn, it will revolve in the direction of rotation of the ring magnet, the induced current diminishing as the speed increases, until upon the armature reaching very nearly the speed of the magnet, just enough current will flow through the coils to keep up the rotation. If, instead of rotating the ring by mechanical power the poles of the same are shifted by the action of the alternate currents in the two circuits, the same results are obtained.

Now compare this system with a continuous current system. In the latter we have alternate currents in the generator and motor coils, and intervening devices for commutating the currents, which on the motor besides effect automatically a progressive shifting or rotation of the poles of the armature; here we have the same elements and identically the same operation, but without the commutating devices. In view of the fact that these devices are entirely unessential to the operation, such alternate current system will—at least in many respects—show a complete similarity with a continuous current system, and the motor will act precisely like a continuous current motor. If the load is augmented the speed is diminished and the rotary effort correspondingly increased, as more current is made to pass through the energizing circuits; load being taken off the speed increases and the current, and consequently the effort, is lessened. The effort, of course, is greatest when the armature is in the state of rest.

But since the analogy is complete, how about the maximum efficiency and current passing through the circuits when the motor is running without any load, one will naturally inquire? It must be remembered that we have to deal with alternate currents. In this form the motor simply represents a transformer in which currents are induced by a dynamic action instead of by reversals, and as it might be expected the efficiency will be maximum at full load. As regards the current, there will be—at least under proper conditions—as wide a variation in its strength as in a transformer, and by observing proper rules, it may be reduced to any desired quantity. Moreover, the current passing through the motor when running free, is no measure for the energy absorbed since the instruments indicate only the numerical sum of the direct and induced electro-motive forces and currents instead of showing their difference.

Regarding the other class of these motors, designed for constant speed, the objections of Dr. Duncan are, in a measure, applicable to certain constructions, but it should be considered that such motors are not expected to run without any, or with a very light load, and, if so, they do not, when properly constructed, present in this respect any more disadvantage than transformers under similar conditions. Besides, both features, rotary effort and tendency to constant speed, may be combined in a motor, and any desired preponderance may be given to either one, and in this manner a motor may be obtained possessing any desired character and capable of satisfying any possible demand in practice.

In conclusion, I will remark, with all respect to Dr. Duncan, that the advantages claimed for my system are not mere assumptions, but results actually obtained, and that for this purpose experiments have been conducted through a long period, and with an assiduity such as only a deep interest in the invention could inspire; nevertheless, although my motor is the fruit of long labor and careful investigation, I do not wish to claim any other merit beyond that of having invented, and I leave it to men more competent than myself to determine the true laws of the principle and the best mode of its application. What the result of these investigations will be the future will tell; but whatever they may be and to whatever this principle may lead, I shall be sufficiently recompensed if later it will be admitted that I have contributed a share, however small, to the advancement of science.

NIKOLA TESLA.

New York, May 26.

Testing the Lights.

The Rutland, Vt., *Herald* gives the following account of a test of the electric light furnished to that city:

Mr. H. P. Brown, an independent electrical engineer of 255 West Fifty-fifth street, New York, was engaged by the trustees to make an expert examination of the electric light service of the village and report to the trustees, which he did last evening.

On Saturday morning Mr. Brown looked at the wires around town, and in the evening he went on Meadow street, lowered the lights and examined them, also the Maple street light and the light at the corner of Main and Madison streets. On Sunday he visited the station, remaining there until 12 o'clock at night. Mr. Brown examined the commercial wires yesterday; and in the evening he made a test at the station with the necessary instruments, an ampere and a volt register of the American system. The test showed a current of 10 amperes, while the contract calls for a current of 9.6 amperes only. The register showed 45 volts at the lowest, and 55 at the highest, while 40 volts is about the average strength of a current required for a 2,000 candle-power light. The showing thus made was peculiarly favorable to the electric light company.

The New Dynamite Gun Ready for the Italian Government.

Captain E. L. Zalinski, the inventor of that terrible engine of war, the pneumatic dynamite torpedo gun, has returned from Philadelphia, where he has been experimenting with the gun recently completed for the Italian Government, which will cost $40,000. The gun was built by William Cramp & Sons, and after its completion was shipped to Jersey City, where a final test will be made about May 1, under the direction of Captain Zalinski.

This gun, in the language of Captain Zalinski, is an ærial torpedo projecting machine, possessing many advantages over the appliances for projecting the torpedo through the water. It is of fifteen inch calibre, and its range will be at least one mile. The full calibre shell will carry 600 pounds of explosive gelatine, equivalent to 852 pounds of dynamite No. 1, or 943 pounds of gun cotton. Shells containing smaller charges can also be thrown. The gun barrel is a light tube, having a smooth bore. The loading is done at the breech. Air at 1,000 pounds pressure is admitted through a balanced valve, made so as to open and close by a single move of the operator. The time of opening and closing can be varied so that the range can be changed without altering either the elevation or pressure.

In order to maintain the pressure as nearly uniform as possible, wrought iron reservoirs of from twelve to sixteen inches in diameter and about twenty feet long are used, the air being supplied to them by any type of high pressure compressor. The power of this fifteen inch gun is very great. It is clear that the value of a weapon which can project a huge mass of powerful explosive equal to three-quarters of the entire bulk of the projectile to a distance of one and a half miles with perfect accuracy cannot be disputed. In Captain Zalinski's office is one of the shells to be used in the big gun. It is made of brass tubings and castings, as light as possible.

A tall tube with spiral vanes attached is annexed to the shell in order to retain it in its proper trajectory. Non-metallic pins in the head keep it central at this point and free from metallic contract, while a leather gas check and vulcanized fibre projections keep it central at the tail. The charge thus far used has been uncamphorized explosive gelatine, having a core of dynamite. The cone is for the purpose of producing a complete detonation of the less sensitive explosive gelatine. In the cruiser *Yorktown* are three of the new fifteen-inch dynamite guns placed abreast and parallel to one another at a fixed angle of sixteen degrees.

The training of the gun is accomplished by steering the vessel, which is done by steam and the running of the engines which drive the twin screws. The range can be varied by means of valves. The guns are required to be loaded twice per minute. The shells will be handled by hydraulic machinery, and provision is to be made for the storage of thirty full calibre shells. The gun for Italy, now completed, is to be trained, elevated and loaded, by hydraulic machinery. It is mounted on an iron base, which, when in place, will rest upon a heavy masonry foundation. The *Yorktown*, when completed, will cost $350,000. This includes the guns. The speed of this vessel will be at least twenty knots. This speed is exceeded by the small and very light torpedo boats built abroad, but the *Yorktown's* hull will be sufficiently strong to be serviceable in rough water, which is not the case with the more lightly built torpedo boats.

The torpedo shell has a double field of action, the over water and under water hull. It is estimated that the decks of the most heavily armed ships will be vulnerable to even the eight-inch torpedo shell charged with 100 pounds of explosive gelatine, and a very large portion of the more heavily armored part of the shell charged with 600 pounds. At the coming trial of the gun intended for the Italian Government, only a few persons will be present. It is designed mainly to satisfy the Pneumatic Dynamite Gun Company of the weapon's efficiency.—*Philadelphia Times.*

TELEGRAPHIC

.... The Postal Telegraph Co's linemen, about a dozen in number, are in Carbondale, Pa., stringing the new wire of that company from New York to Chicago.

.... "I say, Jack, they've got so now that they can draw pictures on paper by telegraph."

"Pooh! that's nothing. I've drawn drafts on my guv'nor by telegraph for the last three years."—*Harvard Lampoon.*

.... In reference to burying the department wires, Superintendent Smith of the telegraph department says that he was ready to begin the work at once, but that some few connections would have to be made in the conduits before the work could be done.

.... Although Sioux City, Iowa, has the Gamewell electrical fire alarm system the Gould American District Telegraph Company of that city has converted itself into a fire alarm system, also extending its wires to the fire department, water-works, police stations, city offices, and other buildings of a public nature. This company now has 300 district telegraph boxes in operation.

....The Electric Gas Lighting Company, of No. 35 Arch street, Boston, has just received a new open-circuit battery. It is known as the "Samson," and consists of a corrugated carbon porous cup, surrounded by a zinc cylinder. The solution employed is sal-ammoniac and water, the same as is now in general use in open-circuit batteries. The peculiarities of the Samson are its electromotive force, its powers of recuperation after short-circuiting, its long life and continued strength of current.

The Gramophone.

Mr. Emile Berliner exhibited the Gramophone at the Franklin Institute recently. This is his own invention, for recording and reproducing speech and sound. It consists of a polished plate, generally of zinc, the surface of which is coated by a preparation made by digesting pure yellow beeswax in cold gasoline or benzine. This plate is fastened horizontally, with the coated surface upward, to a shaft, which, revolving by means of clockwork, in turn revolves the plate. Bearing down upon the oil-coated surface is a stylus tipped with irridium to prevent abrasion by the friction with the plate, which is called the recorder. The stylus communicates with a membranous tympanum, which is thrown into vibration by the voice or sound through a corded tube with a tin, funnel-shaped mouth. Into this funnel-shaped mouth the operator sings or speaks, the membranous tympanum is thrown into vibration and in turn the stylus, which niches the plate or record, now being revolved by the clockwork. After the effusions of the operator have been recorded the clockwork is removed, the stylus and tympanum give way to a similar but smaller contrivance, called the receiver, and a shaft, turned by means of a wheel, with a turning handle attached, is fixed to the shaft, upon which the recording plate is fastened. By means of this wheel the recording plate is revolved, the receiver takes from the grooves upon the plate the vibrations before recorded, and the sound issues out of the tin-funnel mouth.

At the exhibition, the Philadelphia *Press* says that: "William G. Fisher, the musician, was present and sang. Mr. Berliner recited 'Mary Had a Little Lamb,' and made some enumerations. The recording plate was then removed for etching. During the etching process, Mr. Berliner used recording plates heretofore traced. Upon these were recorded various musical selections which the apparatus rendered so that they could easily be heard at the farthest corner of the room. The words now and then were distinct, and all counting of numbers were clear enough to be understood. A metallic ring marred the performances. Mr. Berliner is still at work upon his apparatus and hopes to have it in much better shape by a month."

The Western Union Equipment in Pittsburgh.

A fire in the Western Union building in Pittsburgh made sad havoc with the central office a few months ago. Since that time, many changes and improvements have been made, and it is expected that by July 1st the new offices will be ready. The Pittsburgh *Despatch* speaks of the changes as follows:

New York, Boston and the larger cities are possessed of enviable telegraph facilities, but Pittsburgh is profiting by the very latest scientific and electric inventions, and in one respect leads the world as having the first office to adopt and use a dynamo for a local battery.

The Western Union wires, from Fifth avenue and down Liberty to the Union depot, are being placed under ground by the Wyckoff system of tubing, the main insulation being perfected by cypress wood, it having first undergone a peculiar preparation. The laying of this cable will place everything, in the heart of the city, under ground. It has been found practically impossible to place all of the city wires under ground, on account of the constant changes going on. Besides this, isolated wires could not be so handled at all, so, in all probability, there will always be more or less wires over head. The wires in the new offices are all laid in cables and along the ceiling, instead of on the floor, thus obviating the network that always created more or less apprehension on account of contact with the woodwork, which ultimately burned the building.

A. O. Brown, the Western Union electrician, from New York City, has charge of the placing of the dynamos in the telegraph rooms, and his description of the novel appliances is decidely interesting when robbed of some technical phrasing.

"The company ordered me," said he, "to put in here the very latest and best that could be had, and I have done so.

"Every electrical invention is the more marvelous on account of its simplicity, and so it is with the dynamos and appliances here.

"The electricity for the old building was formerly furnished by 15,000 jars. These were so bulky and troublesome that a separate warehouse was erected for their storing.

"Three times the electrical energy of those 15,000 cells is now furnished by the dynamos in this small room, occupying only one-twentieth of the space that was taken up by the clumsy cells. These dynamos, you see, are laid in three rows or 'gangs,' one gang being positive, another negative, and this middle one reversible, just like an engine. It is kept idle but ready to start if either one or the others should break down.

"You would think it a rather complicated thing to furnish power to one, two, or five hundred local instruments, all on different wires, and all writing different things, yet the power to come from the same source. It is not difficult at all, but delightful in its simplicity. An ordinary loop connection is made, the same as in your incandescent light, and the thing is done.

"These local dynamos have a power of about 15 volts, and no doubt will come into general use on account of their simplicity and economy of room.

"Now, here is a queer little electric engine, and here is something queerer still, called the Root blower. It will work the pneumatic tube from down stairs to the top story. I could easily pick up the whole thing and throw it out of the window, but the little affair can generate a pressure of about seven pounds.

"By the way, a peculiar discovery has been made, and it is probably owing to this discovery that the wonderful tales are going the rounds of the press, about the marvelous future of the pneumatic tube.

"These tubes were formerly worked by pressure, and as I said, this blower can generate a seven-pound atmospheric pressure, but some fellow discovered that they were all the time working the thing the wrong way, so he hitched his machine to the other end, and created a suction. The result certainly was astonishing, for by the suction, or vacuum principle, this Root blower can produce the same work with a 1½-inch vacuum as it formerly did with a 7-pound pressure. This 1½ inch vacuum is only equal to about three-quarters of a pound of atmospheric pressure. I suppose its future will be amazing; so the stories of rapid transit, you see, have some foundation.

"The old lightning arresters will be used where the wires pass into the outer air, but as a double measure of safety the 'snap arrester' will be used at the switchboards. This snapper is an ingenious horseshoe magnet, worked by a spring, and whenever the magnet becomes overcharged on account of the wires coming into contact with an electric wire, or being struck by lightning, the snap gets in its work, the spring flies back, and though they say lightning is rapid, this arrangement is a little more so, and the electric fluid will find itself shut out in the cold world, with no switchboards to smash or lady operators to frighten.

"In all probability the company will furnish its own electric lights, now that it has started in to do things well. The power for all of this is furnished by the Allegheny County Light Company, and you can see how effective it is. I will probably go right back to New York as soon as everything here is finished. I have instructions to stay until the men here have learned all about the system, but a couple of your bright Western Union electricians are catching on so rapidly that I find I am not able to teach them anything. I want to say that I like the managers here, and can congratulate them upon having the most complete electric system in the world.

"In addition to this their offices and operating rooms are handsomer, better ventilated and more comfortable that even New York City, though, of course, not so large."

It is understood that all of the old-timers, from popular manager Clark all down the line through Williams, Bender, Mays, Munson, Moreland, Hill and Ryan, who long ago stopped turning out "copper plates," to take up their more profitable work of directing and testing, will go to their new quarters in a body, and maybe, take a cigar on the company.

The Fun of Changing a Telephone Exchange.

Birmingham, Ala., has recently enjoyed the experience of an improvement in its telephone exchange and service. The fact of the operators at the main office being almost totally unfamiliar with the new switchboard made but little difference, says the Birmingham *Age*, for they are all bright girls, and familiarized themselves with its workings very rapidly. There were ten operators at work, including Miss Ellen Knox, an experienced operator from Atlanta, who will be there several days to instruct the local operators.

The bulk of the trouble came from the subscribers, who would fail to remember that the entire system of numbering had changed.

Quite a number of the mistakes were decidely humorous, but there didn't many folks get mad, because it was their own mistake.

Absent-minded men fared worse, and on several occasions they found themselves repeatedly answering calls by the old numbers.

One man, a first avenue merchant, with rather a torrid temper, called up a friend by the old number. In the new system that number was not in use, but the First avenue man insisted it was, and after repeated attempts called up the manager with, "What is the matter with you? Why in Buzzards' Roost don't yer give me the number I've been yellen for, for an hour—Hey?"

The matter was explained to him over the telephone, but in his excitement he did not understand, until finally one of his clerks, seeing the state of affairs, told him about it, and then Mr. Merchant hung up the instrument with, "Well, well, why in thunder didn't they say so."

A certain young lady over on the south side, who for some weeks past, has talked to her fiancé at 2 o'clock sharp every afternoon; yesterday she called up as usual, and as soon as the answer came said in her sweetest tones, "Walt, those flowers you sent are like you, just too sweet for anything." The young man whose luck gave him Walt's old number, almost lost his breath, and before he recovered it she continued, "I'm going down in a few moments, and say, you meet me near the Wilson House on Second avenue." The astonished young man hung up the ear piece and sat down. A moment later the bell rang again and the colored porter answered it. That wound up the fun.

Somebody called up the *Age* office and, before the city editor had a chance to explain things, the man on the other end of the wire howled: "If you don't hurry up with that bonnet for my wife she'll get a divorce. It's almost train time, and she's in tears."

"What's the name please?" asked the editor.

"——," came the answer.

"Well, this is the *Age* office, and I'll—"

"Great heavens!" and the man hung up the ear piece with a bang.

It won't be long before all grow used to the new numbers, and then Birmingham will have one of the best telephone services in the South.

ELECTRICAL WORK IN THE WEST.

Kansas City and Her Great and Growing Electrical Boom.

OUR SPECIAL CORRESPONDENT GIVES AN INTERESTING ACCOUNT OF IT—ELECTRIC LIGHT, TELEPHONE, TELEGRAPH, AND MOTOR MATTERS ENTERTAININGLY PRESENTED.

Kansas City is the headquarters of the west and southwest in electrical matters of all kinds; and this west and southwest is not simply Kansas, Indian Territory, and Colorado. It includes Iowa, part of Minnesota and Dakota, everything west of Dakota to the Pacific coast tier of states and territories, all the region lying between the northern line of the United States and the region along the Gulf of Mexico and west of the Mississippi. It is to-day the most profitable field of the electrical merchant and dealer. I have spoken in a former letter of the popularity of electrical appliances in this vast region. Popular as they are they are not any more popular than is Kansas City as a source of supplies. To-day, Kansas City electrical establishments are putting in plants of one kind or another or furnishing supplies to Iowa, Missouri, Arkansas, northern Louisiana, southern Dakota, Nebraska, Kansas, Texas, Colorado, New Mexico, Arizona, Utah, Wyoming, Montana, and Idaho. This I know definitely and personally. I have heard and have good reason to believe and it could be easily ascertained, that Kansas City firms are doing work as far east as Ohio and in a southeastern direction as far as Alabama and Georgia. Kansas City's superior railroad facilities and its commercial prominence are the primordial causes of this. *Prima facie* evidence that these statements are not overdrawn is found in the fact that no company engaged in a line of business in any way connected with electrical affairs, whether it be a Chicago or a far eastern concern, makes any pretensions to doing a western or southwestern business without first establishing a branch or agency here or moving here bag and baggage; and still there is room for more and all are eagerly welcomed by the firms already established here, for the demand at present is far in excess of the supply. Thus, we have here the Thomson-Houston and Sawyer-Man and Westinghouse companies represented by the Kansas City Electric Light Company; the Brush, by Mr. Steele; the Edison, by G. W. Hart; the Fort Wayne Jenney, by Mr. Kammeyer; the Sperry, by C. A. Harper; the Hawkeye, of Oskaloosa, Iowa; the New York Accumulator Company, by the Interstate Electric Company; the American, by O. W. Deitsch; the Ball, by A. L. Ellis; the United States Electric Company; the Western Electric Company, by W. P. McQuesten and Ford S. Campbell; the Thomson-Houston, of Boston, by C. S. Rusling; the Electric Supply Company, of Chicago, by C. H. Cone. Then, other companies which have not a permanent agency have agents coming here regularly who linger many moons at a time. The Southwestern Electric Supply Company has its headquarters here. Bruner, Allen, and others look out for miscellaneous electrical supplies, appliances, bells, etc. The Western Union Telegraph Company has here its most important office in the west. The Missouri and Kansas Telephone Company looks after everything in its line west of the Mississippi. The Postal Telegraph Company has its western headquarters here. I have not named all the electrical concerns; I have not attempted to do so. I have aimed to give an idea of Kansas City as an electrical point.

Paul W. Bossart, the manager of the Interstate Electrical Company, has his hands full of business. In addition to important outside contracts in Missouri, Iowa and Kansas, he has a monster local job on hand, nothing less than the establishment of a $75,000 central power station. It is being put in now in the basement of the Keith & Perry building, just going up, and which, when completed, will be one of the most

magnificent quasi-public buildings in this city, of splendid architectural piles. This central plant will have a capacity of 10,000 lights to begin with, which number can and undoubtedly will be increased not long after operations begin. A 400 horse-power boiler is being put in now, and a 100 horse-power engine. The plant will be used at first in supplying simply the Keith & Perry and neighboring buildings with lights, but the company has its eye on the whole town, and Kansas City, Kans., across the river, also. By the accumulator system these distant points can be operated as easily from this central station as the lights on the Keith & Perry building itself, and Mr. Bossart intends to take advantage of everything. The central plant will be operated on the same plan as that at Detroit. The machinery will be run from 1 P. M. to 1 A. M. Those twelve hours will be sufficient for the full twenty-four. During the afternoon hours the plant will be occupied in storing the batteries. When evening comes, and with it a heavy drain on the batteries, the continued operation of the plant will carry the lights right along at their full power, and there will be an excess in the batteries at 1 A. M. sufficient to last until 1 o'clock the next afternoon for what lights may be used during that time. Mr. Bossart recently inspected the operations of the Detroit plant, and was greatly pleased with the cheapness and cleverness of this plan of operation.

I have written before of the success of the accumulator plant put in at Burton, Kans., by the Interstate Company. But is far more successful than I described it. To the Burton Company operating the plant it is simply perfection, and they are so infatuated by it that they want to monopolize it as much as possible, and are now negotiating with the Interstate Company for the rights, machinery, batteries, etc., necessary for operating the system in about ten towns in the region around Burton.

C. T. Ewing, of Cherryvale, Kans., is another convert to the accumulator system. Ewing operates (that is, the company of which he is the head and spirit, the Kansas Electric Light Company), electric light plants in Thayer, Cherryvale and Independence, Kans., and wants to put a plant in Ottawa, Kans., also. There is one electric light plant there already, but Ewing, who controls the Ottawa water-works and knows the town, thinks there is room for another. His scheme is to use the accumulator system in all four of the towns, and he may carry it out yet. He was here this week, and had a long consultation with Bossart over the matter.

A deal is also on between the Independence, Mo., Electric Light Company, and the Interstate. The objection of only one Independence man has prevented the consummation of the deal so far. He doesn't believe the accumulator system will work and won't be convinced. The Interstate is hopeful of putting a plant in at Florence, Kans., also, but this deal is still in its incipient stage. A central station plant is being put in by the Interstate at Missouri Valley, Iowa. A Fort Wayne Jenney dynamo will be used and the Sawyer-Man lamps. It will start with a capacity for 500 lights. Accumulators are being placed in the Excelsior Springs (Mo.) Hotel, with a capacity for 80 lights. C. B. Rhodes, who recently secured a franchise of an electric light plant at Boonville, Mo., has written that he is favorably impressed with the accumulator system, and intends to visit Kansas City and thoroughly examine into it.

Locally, the Interstate Company is endeavoring to get accumulators into the new American Bank building. It already has a plant in Beaham & Moffitt's spice mills in the west bottoms. Additional accumulators are to be put in here for the purpose of furnishing from this plant lights for the Adams House, and also for 200 lights for the new theatre being fitted up in the west bottoms by Mr. Hyde, the theatrical manager of Little Rock, Ark.

Quite a pretty little contest has been going on here for some time over the 20 arc light plant for the Midland Hotel. The bidding got so low that at last two of the light companies offered to put in the plant for nothing and operate it for nothing, and it was hinted that one of these companies offered in addition to pay a certain sum annually for the privilege of putting in the plant and operating it gratis, but I don't really believe it.

The American Electric Light Company has just put in its fourth dynamo, and is now operating 100 arc lights.

The Kansas City Electric Light Company has a 1,000 light alternating current plant *en route* to this city. It is intended for its longest incandescent service. Sawyer-Man lamps will be used. When this plant is in operation the company will then have 3,100 incandescent lights in use, of which 1,500 will be of the alternating current, and 1,600 direct. The company has 700 arc lights in operation, and has a surplus capacity of 150 arc lights. Its arc lights are being rapidly extended. Keeping pace with its prosperity, the company now has its general offices up town, and the genial manager, Mr. E. R. Weeks, now greets his friends in a cosy suite of rooms on the third floor of the National Bank of Kansas City building, on the southeast corner of Fifth and Wyandotte streets. The rooms are light, airy and pleasant, but Mr. Weeks assures me that the boudoir of an oriental princess will be barren poverty itself in comparison with their rich luxuriousness by the time he has them fitted up and furnished to his liking. This building promises to become a sort of electrical exchange building. C. S. Rusling representing the Thomson-Houston of Boston, and C. H. Cone representing the Electrical Supply Company of Chicago, already have their quarters there, and Mr. Weeks stands with open arms to welcome any others. Every electrical man visiting Kansas City is cordially invited by Mr. Weeks to make himself at home in this building.

The Southwestern Electrical Supply Company, now located in the west bottoms, is also contemplating the establishment of an up town office. The company is doing a fine business, and owes it to itself to secure elegant up town quarters. Mr. Edward Lasell, the young and energetic secretary, has just returned from a profitable trip through Kansas. He reports everything "up and at it" in an electrical way throughout the State. Privately he told me that the company was doing a land office business in Trinidad wire, but cautioned me against mentioning it publicly. Paul Bossart says the same about Okonite, and J. W. Godfrey of New York, general manager of the New York Insulated Wire Company, who was through here this week, also gave me a private tip on enormous sales of his brand.

The telephone exchange had a sensation last week in the destruction by fire of the building adjoining its quarters. Superintendent Smith is feeling very proud over the brave manner in which the girls stuck to their posts throughout the excitement, and while the smoke from the burning building was pouring into the exchange. "It was the result of two things," he said. "One was our excellent discipline and the other was the confidence felt in our efficient fire department."

A telephone station has been established at Platte City, Mo., and next week one will be established at Weston. The lines are also being extended toward Pleasant Hill, Holden and Warrensburg, Mo. Superintendent Smith's ambition is to have a great deal of commercial business done by means of the telephone. "We are doing more than both the telegraph companies from Kansas points now," he said, "and we ought to do more from Missouri points, and will, when I can, bring the merchants to realize how much more satisfactory it is than the telegraph. You see, it offers a chance for consultation and that the telegraph can't do."

Mr. Smith is never happy unless he is trying something new. He is now having electric clocks arranged in the Exchange in such a manner that they automatically record all the connections made. Heretofore there has been no reliable way of obtaining that interesting information.

The Warrensburg and Holden, Mo., Pan-electric Exchanges have received notices to quit, and it is thought they will do so peaceably. In a few weeks there will not be an infringing Exchange in the west.

Superintendent Smith was well acquainted with Sim Coy, the Indianapolis politician, recently convicted of tally-sheet election frauds. "In the early days of my Indianapolis experience," he said, "Sim was keeping a little doggery on Virginia avenue. He would not have a telephone put in his place, but he was a constant patron of his neighbors, and I finally shut him off. Well, one morning I woke up to find him elected Councilman, and in a position to get beautifully even with me for shutting him off the telephone. I concluded to go right around and see him. He greeted me with 'Hello, you're the man that shut off my telephoning.' 'Yes,' said I, 'I am him, but you are Councilman now and can have the Exchange if you want it.' Well, it was the first result of his election to the council, and it tickled him to think of my yielding to him, and he was a warm friend of mine and the Exchange ever after."

An electric light plant will be put in at Washington Park, a pleasure resort between here and Independence, Mo.

Superintendent J. E. Jeffries of the Lawrence, Kas., Electric Light Company, while adjusting the brushes the other night, accidentally came in such contact with the brushes that the city circuit used his body as a conductor, and for about twenty seconds gave him a shock he doesn't care to have repeated. The blood was forced through the ends of his fingers and the palms of his hands, and his hands were also burned. He remained conscious through it all, but was unable to regain his power of speech until several moments after his release.

Thomas Cooper, of Richfield, Kas., relates that lightning melted 700 feet of the Syracuse telegraph wire between Johnson City and Ashland, last week. The wire, in falling red-hot to the ground, formed into little bullets, as round and perfect as were ever seen. Nothing but a streak of bullets was left as a mark of the wire that had hung above. Whew! G. M.

Kansas City, Mo., May 21, 1888.

The Bell Telephone Company and State Taxes.

Argument on the question as to whether the American Bell Telephone Company is liable for taxes upon its capital invested in this State and also upon its gross earnings came up before the General Term of the Supreme Court, New York, last week, Judges Van Brunt, Brady and Daniels being on the bench. The company has resisted payment for several years until the amount claimed by the State amounts to $27,537.26.

Deputy Attorney General William A. Post made the argument on behalf of the people. He quoted figures for the five years, from 1882 to 1886 inclusive, and claimed that on the stock capital employed by the company during this term in this State, it should pay as tax $27,537.26. He further insisted that the company was legally bound to pay taxes at the rate of five-tenths of one per cent. on its gross earnings, and penalties for non-payment to the amount of $6,941.64, making a total claim of $34,478.90.

Mr. James C. Carter made the answering argument on behalf of the telephone company. He urged that the object of the company, in order to protect itself, was not to part with its title to the patent but simply to license the use of its contrivances. Mr. Carter argued that the instruments were all made in Massachusetts, the business wholly carried on there, and the company maintained no agent in this State. His concluding point was that the Legislature had no right to impose upon a foreign corporation such a tax.

The court took the papers and reserved its decision.

*** The city council of Fort Worth, Tex., has instructed the city attorney to draw up an ordinance requiring the Bell Telephone Company to run their wires underground. It is claimed that this is done because the telephone company refuses to allow the city officials the free use of telephones.

*** Mr. H. P. Watson, manager of the Telephone Exchange, Mobile, Ala., has been superintending the erection of several cables on St. Michael street. These cables are three-quarters of an inch in diameter and contains fifty-two separate and distinct wires. Where these cables connect with the wires on the poles, lightning arresters are used to prevent accident. The cables were found necessary to reduce the immense number of single wires running into the Western Union building.

Telephonic News

*** J. Lawrence of the Pacific Bell Telephone Co., S. F., is in Phenix, A. T., to organize a telephone company.

*** Kaufman, Kemp, Dallas and Fort Worth, Tex., are to be connected by telephone, and then to be connected in the same manner with other cities.

*** Henry Frease, of the Nickerson, Kan., Electric Light Company, is endavoring to effect district telephonic connection between Nickerson and Hutchinson, Kan.

*** Anniston, Ala., Telephone Exchange is admirably conducted by Manager Dozier. The exchange has over 100 subscribers, and new subscribers are coming in rapidly.

*** The National Telephone Company, of Scotland, are said to have several submarine cables of seven, eight and nine miles in length, which give perfect satisfaction.

*** At Ellsworth, Wis., steps have been taken for the organization of a stock company to run a telephone line between that place and Rock Elm, via El Paso and Olivet, a distance of about twenty-five miles.

*** The City Council of Worcester, Mass., has passed an ordinance to authorize the New England Telephone and Telegraph Company to lay and maintain underground conduits, cables, wires and manholes, and to erect and maintain distributing poles.

*** In the United States Court last week Judge Wallace rendered a decision in the suit of the American Bell Telephone Company against the Universal Dynomaphone Company for infringing on telephone appliances. An injunction was granted in favor of the Bell Company and an accounting ordered.

*** Dr. Robert Amory, president of the Brookline Gas Company, has accepted the position of manager of the Boston Telephone Exchange. Mr. C. A. Perkins, who has held that position for several months, has been made engineer. It is reported that several other changes will be made in the staff of the New England Telephone Company.

*** The Bell Company will open an exchange in Albuquerque at once. A local company had been organized to establish an exchange and use the Cushman instruments, but Mr. H. T. Vaile, the territorial representative of the Bell Company, gave the city an access of information regarding patents and infringements, and the Cushman scheme sunk gently out of sight.

Fire and Water Sicken a Telephone Exchange.

The 39th street Telephone Exchange has a woeful appearance. Fire came in and water followed. The improved multiple system at once became interesting. Two sections were destroyed by fire, and the boys with the hose did the rest. It was such fun to squirt water into the spring jacks! And then copiously shower the bunches of wire back of the switchboard, and see the water taken up as by a sponge. But this meant death to telephone service. And it may mean death, or a spell of sickness, or a lunatic asyslum, to Electrician Seeley.

He is having great fun with fifty linemen hunting up a few million connections. Then he has to explain the thousand puzzling things that show up, some of them very funny, all of them distracting. Every practical telephone man, particularly if he ever had anything to do with the multiple system, can picture the scene.

Top story, switchboard covered with wet plaster, all the office wire soaked and tangled, and bunches of spring-jacks piled around.

The work, night and day, of clearing up the trouble, drying out the wires and testing every line and office connection goes bravely on, and this week will probably see the exchange again in shape for business.

There will be some "cross-talk" for a few weeks, until the moisture is all dried up.

Cars have been ordered from New York for the Sacramento Electric Railway Company.

The Seattle Street Railway Company, of Seattle, W. T., has decided to issue bonds to the amount of $60,000, to convert the present street railway into an electric motor line.

The Council of Philadelphia has granted permission to the the Rapid Transit Electric Company to occupy Twenty-ninth street to test the practicability and plans of operation of said company.

$30,000 has been put up towards the electric railway at Fresno, Cal. One branch will run out J street to the city limits, one to the fair grounds, and one to Paige Park. The Julien system of storage batteries will be used.

F. E. Fisher, the inventor of the electric railroad system that was put in at San Jose, Cal., has returned to San Francisco, with W. A. Jackson, president of the Detroit Electrical Works. They will make some necessary improvements and the road is expected to run at an early day.

Plans for the central station of the Anniston, Ala., electric street railway have been completed by Chisholm & Green, the architects. The building will be two stories high, and contain four stores besides commodious quarters for cars, machinery and equipments. It will be constructed of dressed sandstone.

Manufacturing Notes.

The National Pipe Bending Company, manufacturers of the National Feed-Water Heater, report sales for last month of five 300 horse-power heaters, two 400 horse-power heaters, two 200 horse-power heaters and two 150 horse power heaters; all for electric plants.

The Ball Engine Company of Erie, Pa., have opened an eastern office at No. 13 Cortlandt street New York City. This company has been forced to this move by the increased demand for their engines. Mr. Vincent of the firm of C. S. Vincent & Co., who will be the manager, is a resident of Erie, and has been engaged in the manufacture of engines for the past 20 years, and has been connected with the Ball Engine Company during the latter part of his stay in Erie.

The Taylor Manufacturing Company, of Chambersburg, Pa., builders of the "Beck" automatic engine, and who make a specialty of the manufacture and erection of complete steam plants, especially for electric light stations, have recently added machinery of new and improved design, which increases their facilities for turning out their work in a marked degree. They report the following orders as lately booked: A 100 horse-power steam plant for the electric light station at Coldwater, Mich.; a 100 horse-power complete steam plant, with Beck automatic engine, for the Consolidated Street Railway Company, of Columbus, Ohio, to operate an electrical railway of the Sprague system; a complete steam plant consisting of two 120 horse-power Beck engines, and two 150 horse-power return tubular boilers, to the Electric Company, of Middletown, Conn., for the plant at Hagerstown, Md.; a 67 horse-power complete steam plant for the Thomson-Houston station at Frederick, Md.; a 57 horse-power steam plant for a Thomson-Houston station, to be erected at Reidsville, N. C.; a 7x8 Beck automatic engine, to run a dynamo in the "Hotel Delany," Pittsburgh, Pa.; also a 15 horse-power vertical automatic engine on a combined iron base for dynamo, for operation at Port Huron, Mich. The company also reports sales of three horizontal Automatics to go to Texas, for operating in flour mills, and numerous other sales of automatic engines for planing mill and general manufacturing service, ranging from 8½"x10" cylinder 35 horse-power to 15x18 150 horse-power.

New Improvements in a Large Factory.

The Bishop Gutta Percha Company has just completed an extensive plant for insulating electrical wires with india rubber compounds. Their samples are fully equal in appearance to any we have ever seen and the name of the company is a sufficient guarantee as to quality, for they are the oldest manufacturers of insulated wires in this country, if not the oldest in the world, and they have always had the reputation of making goods of superior quality, and of getting the best prices.

They have heretofore depended on gutta percha for high insulation and still insist that it is the only reliable insulator for submarine cables, but acknowledge that the steam-heating systems render it almost useless for underground where they are adopted.

Their rubber compounds are similar to those used in the celebrated "Hooper's Core," which is the only rubber core used for submarine cables in Europe, and it is claimed has stood longer and more severe tests than any other.

The Bishop Company propose hereafter to use the regular Hooper core insulated by pure rubber next the wire and two protecting coats outside for subaqueous cables when any parts of them are liable to be exposed to the sun, as they often are, in crossing tidal streams and other rivers where the waters are liable to recede and leave the cables bare.

Their two coated insulation is designed for under ground use and also for fastening on the poles of fire-alarm, police-alarm and similar systems—and for all other places where high insulation is necessary and the heat or exposure is two severe for gutta percha.

Mr. Reed says he is not after the people who consider "underwriters" or paraffine insulation good enough; but is willing to guarantee satisfaction as to quality and price to every man who wants a good article.

Personal.

Mr. Clark B. Hotchkiss is still in the South.

Mr. C. J. H. Woodbury, of Boston, was a New York visitor last week.

Dr. Geo. H. Benjamin and Mr. S. S. Wheeler are the examiners on electrical matters for the State Civil Service Examining Board.

Mr. Eddy, of the Eddy Electric Company, was a New York visitor last week, in company with Mr. M. E. Baird of the same company.

Mr. A. J. Mayer, representing the well known firm of A. S. Aloe & Co., of St. Louis, electrical and mathematical instrument makers, is visiting town and capturing the usual amount of business.

Messrs. Cyrus O. Baker, Jr., and A. H. Patterson, of New York, gave Pittsburgh the benefit of their handsome countenances last week. At last accounts Pittsburgh was still there.

Mr. Geo. M. Phelps, Jr., the editor of *Electrical Engineer*, has received many kind words of sympathy over the death of his father, whose long and distinguished services in the electrical field are so widely known.

Mr. Fred. C. Mason, the genial superintendent of Police Telegraph, Brooklyn, is an acknowledged good story teller, and his latest and newest one told to Commodore Cheever completely incapacitated the listener for business for the space of three and a half hours.

Mr. T. Carpenter Smith, of Pittsburgh, has resigned the superintendency of the Allegheny County Light Company, and will become a member of the firm of M. R. Muckle, Jr. & Co., 608 Chestnut street, Philadelphia, mechanical and electrical engineers and contractors. The REVIEW extends its best wishes to the handsome Smith.

Mr. H. C. Adams, the new president of the American Electric Manufacturing Company, is well known in electrical circles, having been for a number of years manager of the New York house of Messrs. Holmes, Booth & Haydens. Mr. Adams will have his office hereafter at No. 3 East Fourteenth street, to which place the general offices of the American Company have been removed from 18 Cortlandt street.

The Candle Power of the Full Moon.

TO THE EDITOR OF ELECTRICAL REVIEW:

The writer made a rough estimate of the candle-power of the moon, in the evening of Nov. 30, 1887, the full moon having occurred at 10 *h*. 20 *m*. on the morning of that day. The sky was very clear. An electric arc lamp was burning over the entrance to the Young Men's Christian Association building in Boston. The lamp being provided with a porcelain shade, I estimated its candle-power at 400. I moved about till my position gave the shadows due to the lamp and the moon as nearly of equal intensity as could be judged, and paced the distance out from the lamp. Finding from the estimated hight of the lamp, its distance from my position, taking the distance of the moon at 240,000 miles, and reckoning the candle-powers of the lamp and the moon proportional to the squares of the distances, the candle-power of the moon came out 134,000,000,000,000,000, or say somewhere near $(10)^{17}$ candles. This is not far from the number of candles, each one-half inch in diameter, that could stand side by side on one-half the surface of the moon.

Such an estimate as the above is, of course, liable to much error, but probably indicates approximately the order of magnitude of the candle-power. If any other readers of the ELECTRICAL REVIEW have made similar observations it would be interesting to have them published for comparison.

Boston, May 23, 1888. J. J. SKINNER.

—— The City Council of Nashville, Tenn., granted the right of way to the Edison Electric Light Company.

—— Chambersburg, Pa., town council has ordered the electric light to be extended, and ten more lights will be added to the system. The fire alarm system will also be enlarged and improved.

—— It is claimed that the new Staten Island ferry boats, "Erastus Wiman" and "Robert Garrett," will be the finest ferry boats in the world. The boats will be supplied with a double electric light plant.

—— A branch station of the Edison Company on Liberty street, New York, containing four dynamos, was destroyed by fire last week. The station was not in use at the time, and is only used in the winter months. The dynamos were entirely ruined.

——The annual meeting of stockholders of the Mobile Electric Lighting Company for the election of directors to serve for the ensuing year, will take place on Monday, June 11, next, at the company's station. A vote will also be taken on that day on the question of increase of the plant. H. W. Shields, secretary.

—— A St. Joseph, Mo., special says that the cars of the Union electric line will be running from New Ulm Park to the stock yards, a distance of five miles, within two weeks. The line has been in operation for a distance of one mile for several months and thoroughly tested. It is pronounced a success and superior to the cable or dummy lines. Sprague motors are used.

Complete Facilities for Incandescent Lamp Manufacture.

The new lamp factory of the Sawyer-Man Company, at 510 West Twenty-third street, this city, is probably the most extensive, well organized and equipped, to be found in the country, with ample facilities for turning out incandescent lamps of any style in sufficient quantities to meet the demands of all the companies for incandescent lamps. It is well worth a visit from all parties interested in the great development daily going on in the electrical field.

The Sprague Company have just received orders for a number of motors to be shipped to Paris. They report large sales of standard motors for the last two weeks.

Jersey City, N. J.—The Mather-Tucker Electric Company; capital, $350,000; H. G. Cheney and others, incorporators.

Milwaukee, Wis.—The Automatic Fire Service Company; capital, $200,000; William Sanderson and others, incorporators.

New York City.—The Primary Electric Company has been incorporated; capital, $240,000; Hans Joachim Von Metzradt and others, incorporators.

Allegheny City, Pa.—The Allegheny Illuminating Company has been incorporated; capital, $35,000; John M. Cleare and others, incorporators.

Delaware, Ohio.—The Delaware Edison Illuminating Company has been incorporated; capital, $50,000; B. W. Brown and others, incorporators.

Phœnixville, Pa.—The Phœnixville Electric Light and Power Company has been incorporated; capital, $5,000; J. L. Brower and others, incorporators.

Minneapolis, Minn.—The Benton Electric Light Company, with a capital of $10,000, has been incorporated by Thomas P. Benton, G. F. Wescott, and others.

Gravesend, N. Y.—The Atlantic Electric Light Company of Gravesend, N. Y., has been incorporated by J. J. Powers and others, with a capital stock of $52,000.

Garden City, Kans.—The Garden City Electric Light, Heating and Power Company has been incorporated; capital, $100,000; S. M. Keller and others, incorporators.

Chicago, Ill.—The Edgewater Electric Light Company, of Chicago, with $100,000 capital stock; incorporators—John Lewis Cochran, S. Wilmer Connel, and John C. Scovell.

Laramie, W. T.—The Laramie Electric Gas Light and Fuel Company is officered as follows: M. N. Grant, president; I. H. Symons, vice-president; R. M. Jones, manager.

Bridgewater, Mass.—The Bridgewater Electric Light and Power Company, Bridgewater, Mass., has been organized with the following officers: Treasurer, R. C. Breck; clerk, E. C. Linfield.

Portland, Me.—The Johnson Electric Train Signal Company has been organized; capital stock, $500,000; president, Samuel P. Abbott, Watertown, Mass.; treasurer, Wm. C. Johnson, Jr., Lynn, Mass.

Chicago, Ill.—The Charles Munson Belting Company; capital, $100,000; for the manufacture of leather belting and mill-furnishing supplies; incorporators, Charles Munson, John M. Thomas, and Frank G. Mars.

Flushing, N. Y.—The Equitable Gas Light Company, of Flushing; capital, $50,000; Robert M. C. Graham, Harry Keene, Malcolm Graham, J. Wahr Morgan Draper, and Edward H. Roth, are trustees.

Portland, Me.—The Automatic Heater Company; capital stock of $8,000; the stockholders are Charles H. Abbott, Boston, Mass.; Charles A. Gleason and James Stuart Murphy, Lowell, Mass; Charles H. Abbott is president, Charles A. Gleason is treasurer.

Chicago, Ill.—The American Cable and Electrical Conduit Company, of Chicago; capital stock, $500,000; to construct and operate underground conduits and cables and electrical railways; incorporators—Oliver T. Thompson, Thomas Somerville, Abram D. Hazen, Wm. R. Riley, and Isaac L. Johnson.

Shreveport, La.—The directors of the Incandescent Electric Light Company, a new organization, met and elected the following officers: L. M. Carter, president; A. S. Toomb, vice-president; Ben Ripinsky, secretary, and Sam. N. Ford, treasurer. The company will be ready for business within two weeks.

The Electric Light in Boilers.

A German scientist has recently been conducting some experiments with electric lights for the purpose of watching the action that goes on inside a steam boiler when it is performing its regular work. According to Mr. E. Blass, the originator of the idea, the details of the apparatus were as follows, which we get from the *American Journal of Railway Appliances:* A hole was made in the upper part of the shell, *S*, and a stuffing box was attached. Through this stuffing box a thick glass tube, T, was passed, and the joint between this tube and the shell was made steam tight by suitable packing. A small incandescent electric lamp was then lowered into the tube as shown in the cut, and by means of this and a galvanic battery the entire interior of the boiler could be lit up.

The sight slot was attached to head of the boiler, as shown on the right of the cut. A small casting with flanges at both ends was first riveted to the head, and to the outer end of this a glass plate, *A*, three-eighths of an inch thick, was secured by means of bolts passing through a slotted face plate. Gaskets were placed between the glass and the metal, to make the whole steam tight. The slot in the face plate covering the glass *A* was five inches long and half an inch wide, and through this the observations was made.

A cock, *B*, was fitted to the main casting, and a long slot was cut through it, as shown. When this cock was opened by a wrench, the apparatus was ready for use; and by closing the cock the glass plate *A* could be relieved of the pressure upon it.

We are not aware that any discoveries of practical importance have been made with this apparatus; but the experiments were very interesting. It has been proposed to apply the same device to the cylinders of simple, compound and triple expansion engines, in the hope of procuring direct evidence concerning cylinder condensation; but as the time during which this condensation takes place is so very short, it is probable that the water is in such a fine state of subdivision that it does not make the steam appreciably opaque.

The Electric Thermometer Dial.

Chief Signal Officer Greeley will soon place a self-registering thermometer in all the signal stations throughout the country. These instruments are the invention of Andrew S. Draper, of New York. They will doubtless be found very convenient to citizens generally.

More Work for the Electrical Subway.

Commissioner Newton has granted permits to the Consolidated Telegraph and Electrical Subway Company to open several streets for the purpose of putting down electrical conduits.

—— The county electrician of Cook Co., Ill., Mr. C. F. Oakley, writes that the lamps of the Vitrite & Luminoid Company, which were put in the five county buildings are giving the best of satisfaction. He states: "The lamps give a perfect white light, and do not discolor. From tests that I have made, I find the average life of your lamps up to date is from 1,200 to 1,500 hours." This testimonial represents over 2,500 lamps.

—— The Underground Electric Conduit and Water-pipe Company, of Denver, recently incorporated, has disposed of all its stock, and will begin work at an early date.

The Jarvis Engineering Co. are unusually busy just now putting in the following steam plants: Edison Electric Light Co., Newport, R. I., 200 H. P.; Meriden Electric R. R., Meriden, Conn., Daft system, 200 H. P.; Quincy Electric Light Co., Quincy, Mass., 150 H. P.; Malden Electric Light Co., Malden, Mass., 450 H. P.; Burlington Gas Co., Burlington, Vt., 150 H. P.; Newport Incandescent Electric Light Co., Newport, R. I., 150 H. P. All the above stations are equipped with Armington & Sim's engines, and Jarvis furnaces to burn cheap fuels; also Sheffield grates, National heaters, and Korting injectors.

Not Neighborly.

Memphis, Tenn., is having trouble with the rivalries and fights of its various electrical companies, and the council has adopted the following:

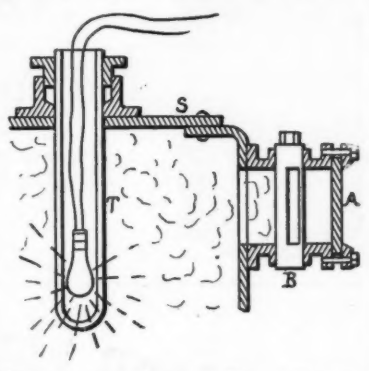
"Whereas, complaint is being made from time to time to the Legislative Council as to the danger resulting from the proximity of the wires of the Electric Light Companies and Cumberland Telephone, and their frequent contact with each other, endangering life;

"Resolved, That the respective companies be required to place their wires upon separate poles, and so located as to prevent any contact or induction."

Long Distance Lighting.

The Westinghouse Electric Company are said to be engaged making experiments to find out the distributing power of incandescent lights. They have several lights put up at Edgewood and Swissvale, Pa., which were until quite recently farther away from the light supplying dynamo than any other lights in the world. The distance from the dynamo to the lights was four miles. Since then, however, several improvements have been made by the company.

The Westinghouse Company is now erecting two plants, one at Bernardino and the



INCANDESCENT LAMP IN USE IN BOILER EXAMINATION.

other at Riverside, Cal., where the electric power is respectively seven miles and three miles away from the lights.

—— At the meeting of the New York Board of Aldermen, Mayor Hewitt submitted a veto message of the ordinance providing for the licensing of electric light employés under penalty. The Mayor says the Aldermen have no jurisdiction, and that the Board of Electrical Control has.

——Electric lights have been in use on the Wurtemburg Railway lines in Germany for some time and the cost for a twelve and a half candle-power lamp, based on the use of the light for 2,100 hours per annum, it is reported, varies from .62 cent to .88 cent per hour, the average cost being considerable less than the cost of lighting by oil gas.

—— In the election held in Boonville, Mo., May 8, to determine whether the city would use the electric light, on the ordinance granting C. B. Rhodes the privilege of putting in the plant and pledging the city to use it for ten years, only fifty-nine out of 387 votes were against the proposition. Mr. Rhodes says he will begin work on the plant at once. The Sperry arc and the Swan incandescent lights will be used.

—— Three electric light light companies are now struggling to give the best light in Lawrence, Kas. Pierson Bros. have the oldest plant and are doubling its capacity. The water works company has established electric light works in connection with its plant and has just begun operations. J. D. Bowersock and others have organized the third company and this company claims that when they get started, the citizens of Lawrence will think they never saw an electric light before, so bright and so silvery will be the gleams furnished by the new company. The new plant will cost about $30,000. It will use the Thompson-Houston arc and the alternating current incandescent lights. A first-class power house will be erected and equipped with two engines of 200 horse-power each, and a dynamo capacity of seventy arc and 1,000 incandescent lights. Water power will be used, enabling the company to give low rates, but boilers will be placed in position to be used if the water power should go back on them at any time.

—— The Hiawatha (Kans.) Opera House is being fitted up with electric lights.

—— Bloomington, Ill., is now lighted up with 300 arc lights and nearly 1,000 incandescents.

—— University Place, a suburb of Des Moines, Iowa, is organizing an electric light company.

—— Sutton, Neb., intends to have an electric light plant in connection with a water-works system.

—— The machinery of the Trinidad, Col., Electric Light Company is in position, and the plant begins operations this week.

—— The Eureka, Kans., council has contracted for thirteen arc lights of 2,000 candle power each for three years at the rate of $10 a month.

—— An electric plant is being erected at the Big Bend Tunnel in Butte County, Cal. There will be thirty-four miles of electric light wires skirting the Feather river.

—— The council of Oberlin, Kans., has been petitioned to order an election on the proposition of issuing bonds for $30,000 for an electric light plant and water-works.

—— Geo. D. Copeland, president of the San Diego, Cal., electric railroad, has been in San Francisco, investigating the merits of the different electric light systems in order to establish an opposition company.

—— The Electrical Society of Philadelphia has been making some interesting experiments with automatic safety circuit breakers for electric light lines. A number of inventions were tested and their various qualifications discussed.

—— Mayor Mason was right when he said in his inaugural that "the question of light would come before the new council." Indeed it had come and come to stay. It was Alderman Charley Lamp, and he was filled and trimmed for the occasion.—*Bloomington* (Ill.) *Eye.*

—— The Sioux City (Iowa) Electric Light Company will build a new power house. It will be 50 feet front by 100 feet deep, and two stories high. The engine power, including the one in use now, will be 200 horse power. Wires are being strung for a Westinghouse incandescent electric light service. Two machines, each of 650 light capacity, will be put in.

—— T. M. Wilson, who has been employed by the Hutchinson (Kas.) Water, Light and Telephone Company for about two years as manager of the telephone and electric light department, has severed his connection with that institution and will sail for Buenos Ayres, South America, where he will engage in the same business. E. M. Van Frank, who has been for some time engaged in wiring buildings for the electric light service, will accompany Mr. Wilson.

—— The Ottawa, Kan., *Republican* is responsible for the following story: "Adam Weaver had an imperfect incandescent electric lamp globe in a small box in his house. The wire not being joined, the circuit was broken, and consequently it could not be used, which was the reason of its being laid aside. To-day the globe flew into a thousand pieces with a loud report, scattering the fragments like fine dust all over the room, and slightly injuring Miss Weaver. It was not attached to the wires, never had been, and no person being near where it was lying and had lain for many a day, it is a mystery nobody has yet been able to solve."

—— Considerable excitement has been caused at Lebanon, Mo., by the discovery of electricity in the water-works well. Some time ago, during the dry weather, the St. Louis & San Francisco Railroad Company put a pump in the well, but before connection was made with their tank, water was plenty and the well was abandoned. An attempt was made to remove the pump, when it was found that some part of the pump was fast to the piping, which extends down about 300 feet. It was also found that by the application of small steel articles that the pipe is highly magnetic, and steel readily adheres to it. The well is 1,200 feet deep, and has 900 feet of water in it. It has filled in and been drilled out three times

ELECTRIC LIGHT NEWS

—— The subject of electric lights is being agitated in Seneca, Kas.

—— An electric light plant is to be established at Buffalo Gap, Wyo. Ter.

—— The Birmingham (Ala.) Safe and Lock Co. will erect an electric light plant.

—— Norfolk, Neb., has subscribed $5,000 towards securing an electric lighting plant.

—— The machinery of the electric light plant of Marshall, Tex., was successfully tested last week.

—— Cherryfield, Me., is to have the electric light. A company has been formed with a capital of $4,000 and 100 lights ordered.

—— C. B. Hopkins has organized an electric light and power company at Walla Walla, W. T, and will erect plant at once.

—— The Sperry Electric Light Company of Chicago, will put in an incandescent system for the Rich Hill, Mo., Electric Light Company.

—— At Dunkirk, N. Y., the electric light poles are being planted and the contract for the erection of the electric light building has been let to John Hilliard.

—— Ground has been broken for the buildings of iron and steel works at Superior, Wis., which, when completed, will cost $300,000, and give employment to 500 men.

—— The incandescent system of lights in Gadsden, Ala., is said to be a complete success. The first lights were turned on by Mrs. W. P. Lay, wife of the general manager.

—— Sea Isle, N. J., has had a central station of the Edison system put in, through the efforts of Mr. Geo. W. Silsby, of 65 Fifth avenue. The station comprises a capacity of 2,500.

—— The incandescent electric light plant of the Frooks Locomotive Works, at Dunkirk, N. Y., has been completed. There are 150 lights in the plant and they are very satisfactory.

—— The electric light plant at Florence, Kas., under the management of Mr. Kapp, began operations last week, with a general celebration on the part of the citizens, and a water-works display.

—— The Electric Construction Co., of New Jersey, is negotiating to secure a site at Sausalito, Cal., on which to establish a Pacific Coast department for the manufacture of storage batteries.

—— Wieland's Brewery, San Francisco, Cal., has been using five arc lamps, put in by the Pacific Electrical Construction Co. The plant will be now increased. A 35 h. p. engine is being put in the brewery.

—— At Fulton, N. Y., the Citizens' Electric Company was awarded the contract for street lighting for one year at $32.98 a year for each arc, and thirty-seven and one-fourth cents a year for each incandescent lamp.

—— A contract has been made by C. J. Carney, superintendent of machinery of the water works at Dunkirk, N. Y., for two fifty-horse power Rice automatic engines to run the electric light machinery for lighting the town.

—— The San Rafael Gas Company, San Rafael, Cal., has put in an electric light plant, with a sixty horse-power boiler and two Brush dynamos of thirty-light capacity each. There are twenty-one masts and lamps. The company has a five years' franchise.

—— The Laredo, Tex., electric light plant is in operation, and gives unqualified satisfaction. An enlargement is already deemed nearly necessary. Mr. James McNeill, an expert electrician sent out by the Edison Electric Light Company, of New York, superintended the starting of operations.

ELECTRICAL PATENTS

(Copies of any Patents in the following List will be sent to any address on receipt of twenty-five cents.)

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING MAY 22, 1888.

383,095 Differential expansion devise for galvanometers; William H. Bristol and William E. Geyer, Hoboken, N. J.

383,096 Anti-induction composition for electric cables.

383,097 Support for electric wires. 383,098 Covering for electric wires and cables; David Brooks, Jr., Philadelphia, Pa., assignor to the Electric Cable Construction and Maintenance Company, same place.

383,105 Electrophorous; James D. Culp, San Felipe, Cal.

383,113 Dynamo electric machine. 383,114 Automatic tightening device for armatures of dynamo electric machines; James W. Easton, New York, N. Y.

383,140 Manufacture of incandescent electric lamps; Otto A Moses, New York, N. Y., assignor to the Westinghouse Electric Company, Pittsburgh, Pa.

383,150 Secondary battery; Samuel Russell, Brooklyn, N. Y., assignor to the Central Electrical Company of New York.

383,158 383,332 Combined gas and electric light fixture; Samuel B. H. Vance, New York, N. Y.

383,178 Machine for splicing wire; William L. Haag, Lansing, Mich.

383,184 Electrical apparatus for purifying water; Albert R. Leeds, Hoboken, N. J.

383,193 Secondary battery; John S. Sellon, Sydenham, County of Kent, England, assignor to the Electrical Accumulator Company of New York.

383,216 Secondary battery; Ludwig Epstein, Martinikenfelde, near Berlin, Prussia, Germany.

383,220 District telegraph call box; James B. Gill, San Francisco, Cal.

383,263 Galvanic battery excitant; Thomas P. Whittier, East Saginaw, Mich.

383,269 Telephone conveyer; Samuel R. Ballad, Pittsburgh, Pa., assignor of one-half to George V. Marshall, same place.

383 271 Battery zinc; John Beattie, Jr., Fall River, Mass., assignor to the Beattie Battery Zinc and Electrical Company, same place.

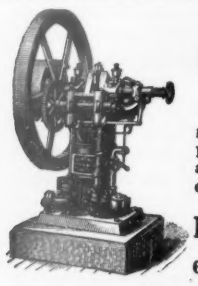
383,273 Electrical tramway. 383,274. Electrical tramway; Henry T. Blake, New Haven, and Clarence Sterling, Bridgeport, Ct.

383,320 Dynamo electric machine; Lawrence N. P. Poland, Cincinnati, Ohio.

383,345 Rheostat; Frank J. Crouch, Eugene City, Oregon.

383,385 Testing machine; Arthur V. Abbot, Brooklyn, N. Y., assignor to E. & T. Fairbanks & Company, St. Johnsbury, Vt.

383,411 Electric lamp; Eli. C. Ohmart, New York, N. Y., assignor, by mesne assignments, to the Ohmart-Homans Electric Lighting Company of New York.



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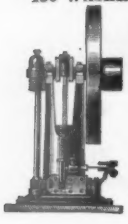

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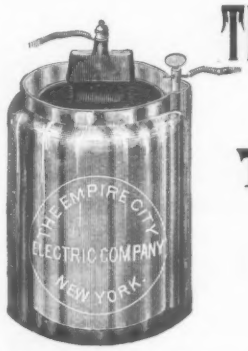

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